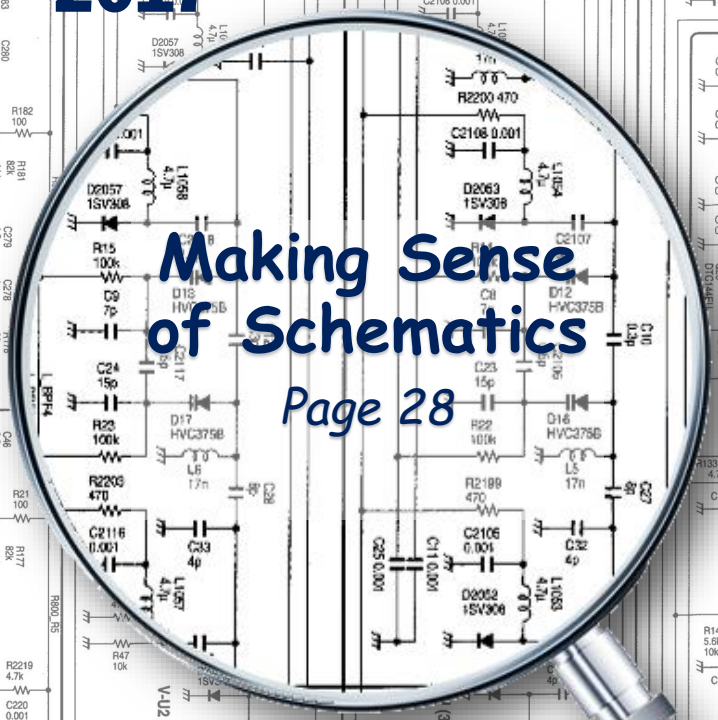
SARC

The Surrey Amateur Radio Club

February 2017

Communicator



Making Sense of Schematics

Page 28

January 2017 Meeting Minutes

SURREY AMATEUR RADIO CLUB

TELEPHONE & ADDRESS

(778) 806-4662

Mailing Address
12144 - 57A Avenue
Surrey, BC V3X 2S3
SARC@ve7sar.net

Operations & Training Centre
14265 - 57 Avenue
Surrey, BC

EDITOR
John Schouten VE7TI
SARCcommunicator @ve7sar.net

WEBMASTER
Jeremy Morse VE7TMY
Webmaster@ve7sar.net

REPEATER MANAGER
Sheldon Ward VA7XNL
Repeater@ve7sar.net

MEMBERSHIP
John Brodie VA7XB
Membership@ve7sar.net

NET MANAGER
Rob Gilchrist VE7CZV

QSL MANAGER
Heinz Buhrig VA7AQ

IN THIS ISSUE
click on the page number below

Announcements

Stan Williams welcomed everyone to the meeting.

Financial Report: Scott Hawrelak VE7HA

Scott provided current balances.

Name tags have been printed and can be picked up tonight for those that requested them. Scott will have another name tag order in a couple months from now just let him know.

The Paypal account is empty it was transferred into the main account at the end of the year.

Membership Report: John Brodie VA7XB

We may have reduced our membership by 8-10 over the last year but this is typical when we gain/lose members from the Basic Ham Class who got a free membership but don't renew. We currently have 97 members in good standing.

Basic Ham Class: John Brodie VA7XB

We need to order approx 20 books ~$800. There has been early interest in the class upcoming in March so far, with 4-5 students registered. John Brodie moved that we purchase 20 study manuals from Coax Publications. Motion Carried

Communicator

No report as John Schouten VE7TI is absent but a reminder that John is always looking for articles and ideas. They can be sent to SARCcommunicator@outlook.com

OTC (Operations Training Centre): John Brodie VA7XB

There still is no heat working but a part for the heating system has been ordered and not installed yet. John Brodie has installed a temporary heater in the radio room that keeps it comfortable in the interim. A coax connector has pulled loose from the beam but it's been quite cold lately to attempt a repair. This upcoming weekend some repairs will be attempted.

The lottery grant was turned down last fall and we have appealed the decision but have not heard back yet. Marvin Hunt MLA has indicated that provincial funds may be available and a request has been submitted describing our requirements.

Repeater: Sheldon Ward VA7XNL

No change, IRLP 9100 still blocked on one of the nodes and a site visit still pending.

VE100VIMY:

John VA7XB has volunteered to operate from his home QTH on Feb 17th Friday for VE100VIMY and Sheldon VA7XNL from the OTC. A 7am - 5pm block has been assigned to our club.

Weekly Net: Rob Gilchrist VE7CZV

Rob Gilchrist is our new net manager and getting organized for the role now. John Brodie has noticed that several times the net control operator has been missing and backups need to jump in. Jeremy is able to update the website for the schedule.

Website: Jeremy Morse VE7TMY

The Ham class notice is on the front page of our website. And just a reminder that director contact info is on the website as well for those that may need it.

Contest Group:

The RAC winter contest was recently held at John Brodie's QTH Dec 17th.

The ARRL RTTY contest was on Jan 7-8

As a result of the Canada 150 celebrations, CG and CF special event prefixes are available for Canadian Ham operators in 2017 and this may stir up more interest in contesting.

Feb 4 BC QSO Party a 12 hour contest where the world wants to contact us and it should be busy.

Field Day

Is coming up the last full Weekend in June, on the 24/25, 2017

The Field Day committee will be created and will have its first meeting February 1@7:00pm at the OTC. Those interested in planning and preparing for field day should attend. Stan, Sheldon and Jeremy volunteered to be on the FD Committee.

Coffee Break

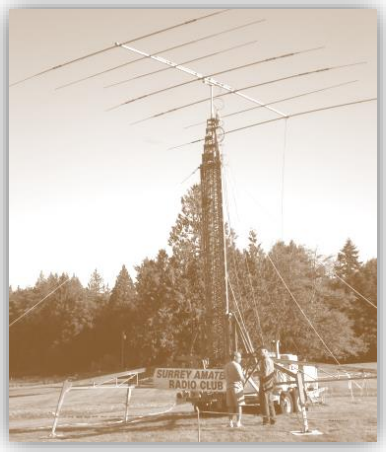
Presentation

Some last minute technical issues prevented Stan Williams VA7NF from continuing with his presentation on SDR and the Flex 6700 demo.

Sheldon Ward VA7XNL presented an update on the items available for purchase by club members. The end date of the silent auction is the last day in February. Anyone interested in items should contact Sheldon and/or place their bids on the sheets provided.

Jeremy Morse VE7TMY provided an impromptu demo/talk about PC SDR receivers. Jeremy prepared his laptop with a $20 RTL-SDR USB dongle as well as a HackRF device. A second RTL-SDR dongle and a "Ham it up" up converter were passed around the room.

~ Jeremy VE7MTY
Recording Secretary



The **SARC Communicator** is published monthly except July and August for members of the Surrey Amateur Radio Club.

To subscribe, unsubscribe or change your address for e-mail delivery of this newsletter, notify **SARCcommunicator @ ve7sar.net**

Non-members living in the Greater Vancouver area are asked to subscribe with a $5 annual donation towards our Field Day fund.

SARC maintains a website at **www.ve7sar.net** and a Media website at **docs.com/surrey-amateur-radio-club** that includes past issues of The Communicator, club history, news, photos, videos and other information.

Kalmar Koffee Klatch Reminder

The SARC Weekly Koffee Klatch is on Saturday at the Kalmar Restaurant at 80th and King George Hwy in Surrey at 9:00 am. Bring your significant other, bring your family, see old friends and have fun.

On The Cover…

Reading schematics, especially for devices with complex circuitry is not for the faint of heart. This month our regular guest contributor, Adam N1RKW, has written an in-depth article on the subject that newbies in particular should find useful. You can access it starting on page 28.

At The Last Meeting

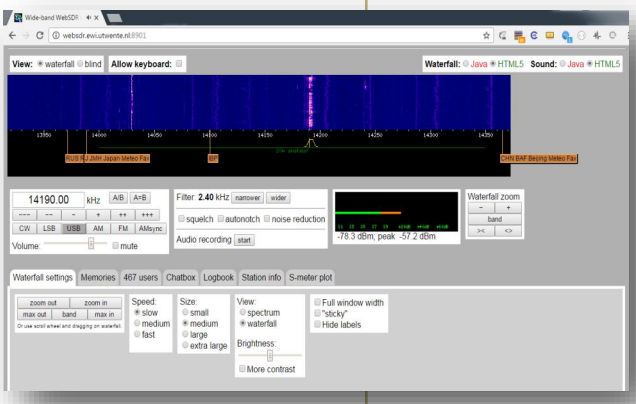
Jeremy Morse VE7TMY

Exploring SDR Dongles

If you don't have an RTL-SDR dongle or access to a quality outdoor antenna, you can still experiment with an SDR receiver.

The RTL-SDR is an ultra cheap software defined radio based on DVB-T TV tuners with RTL2832U chips. The RTL-SDR can be used as a wide band radio scanner. It may interest ham radio enthusiasts, hardware hackers, tinkerers and anyone interested in RF.

The RTL-SDR USB Dongle was originally used in satellite reception on computers. Later Antti Palosaari, Eric Fry and Osmocom worked together to establish a new personal computer driver that allowed it to receive RF. This essentially turns your PC into a high end radio scanner. An RF waterfall and many other features, not even found on the most expensive scanners on the market, are now available.



If you don't have an RTL-SDR dongle or access to a quality outdoor antenna, you can still experiment with an SDR receiver. Individual operators, clubs and universities are allowing remote users to access many SDR receivers on-line.

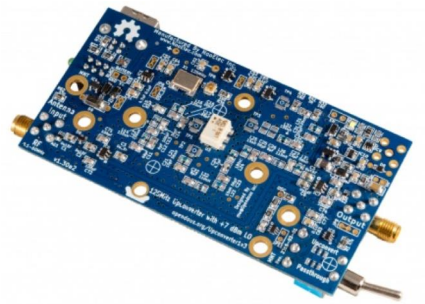
http://www.websdr.org/ is a web SDR site that has more than 100 receivers available worldwide. The University of Twente in The Netherlands is one of the most popular often hosting 400-500 users at a time.

That system is currently composed of a "Mini-Whip" antenna, a homebuilt SDR board (as pictured - see here for background) which samples the **entire** shortwave spectrum and sends all of this via a gigabit ethernet link to a PC, where a special version of the WebSDR server software processes it. The Mini-Whip is based on a design by PA0RDT - see some pictures. The active receiving element is about 5 by 10 cm large. Such an antenna only works well with a good grounding; theirs is on top of a 20m high building, the upper part of which is all metal. You can access this site and use the receiver via this WebSDR link: http://websdr.ewi.utwente.nl:8901/

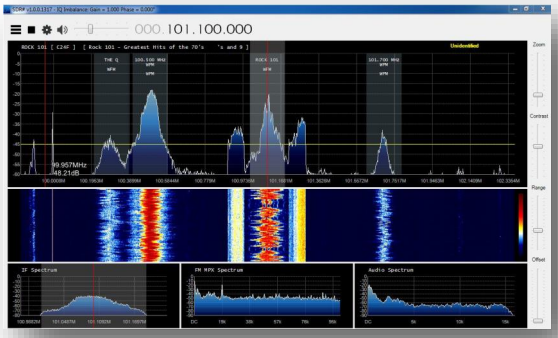
Many of these devices are higher-end equipment than a $20 RTL-SDR but the theory is the same. Don't sell the $20 dongle short, it works quite well and you can have a lot of fun with it. The out of the box RTL-SDR USB Dongle is not capable of receiving HF because it's lower bandwidth is between 22 and 52 MHz, thus well above the 20-160m HF bands.

With the up-converter board, signals are received on the actual HF bands through the antenna and bumped up into the bandwidth specifications of the RTL-SDR device so it can receive them. Software like SDR Sharp allows for an up shift in frequency so the operator can read the band as if listening directly to the 20-160m bands.

Jeremy provided a software demo of SDR Sharp but, due to compromised indoor antenna, only the FM Broadcast band was shown. Differences between the waterfall bandwidth of the RTL-SDR vs the HackRF were also demonstrated.



The HackRF Device is a more robust example of an affordable SDR device that can be used on a PC. It can receive as well as transmit. Its main advantage over the RTL-SDR is that it can receive HF without an up converter board. It also has a receive range between 1 MHz and 6 GHz. It can also be used to view a wider range on the waterfall with its higher sampling rate.



The free SDR software

Many other pieces of software can be used for RTL-SDR

http://www.rtl-sdr.com/big-list-rtl-sdr-supported-software/

Jeremy demo'd both a web SDR and the Kiwi Web SDR from different websites

http://sdr.hu/?top=kiwi offers a list of available remote SDR stations. The University of Victoria is one of the most popular. Each station allows a different number of remote users and this can extend your world wide listening easily. More details can be found here: http://kiwisdr.com/kiwisdr/

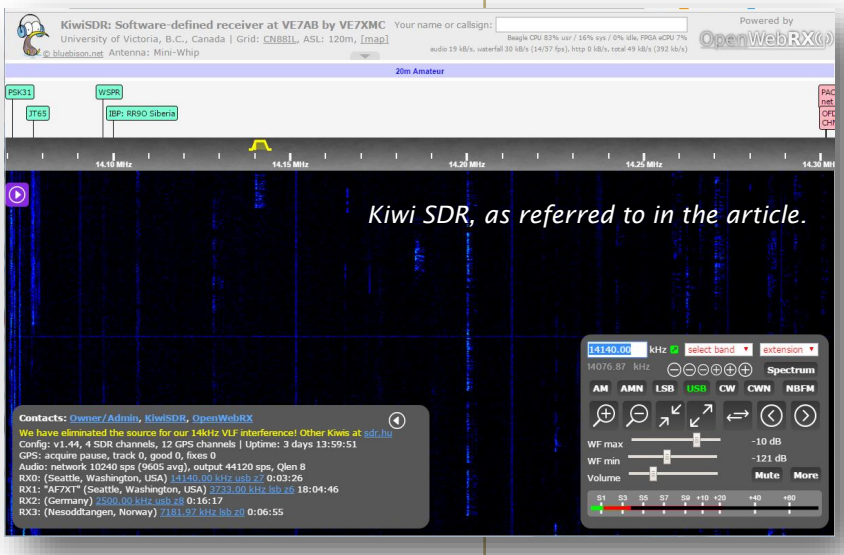
Other References:

http://www.rtl-sdr.com/roundup-software-defined-radios/

http://www.rtl-sdr.com/review-airspy-vs-sdrplay-rsp-vs-hackrf/

Sheldon Ward has proposed that SARC should consider hosting a web SDR device using our wideband receive antenna at the OTC. I also have an interest in this side of the hobby and will be experimenting along with Sheldon on this project.

~ Jeremy VE7MTY



Kiwi SDR, as referred to in the article.

Club Station News

John Brodie VA7XB

Some Progress But Further Issues...

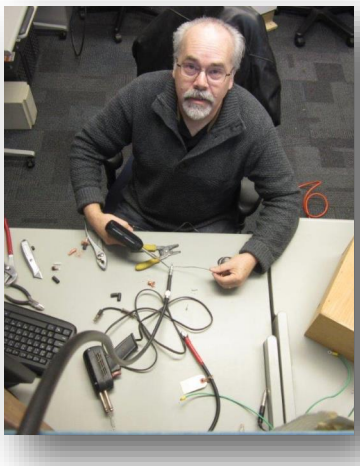
A few hardy members got into their cold-weather gear over the weekend of January 15th to carry out some repairs in preparation for February contests. Assisting with the work were Steve VE7XSM, Stan VA7NF, Sheldon VA7XNL and John VA7XB. First job was to lower the tower to the ground to access the failed coax connection where it connects to the beam. This work has to be done on a weekend, to avoid parked cars and traffic in the parking lot. A layer of ice on the ground made this treacherous work, but it was completed without mishap.

Steve undertook to install a new solder-type UHF connector to the end of the coax, while the rest of the crew inspected the tower and beam and lubricated the pulleys. Once all that was done, the coax was reconnected and sealed against entry of moisture and the tower raised to the vertical position. Rope was attached to the coax to allow it to be pulled away from the tower when the time comes to crank it up to full height, and thus avoid the same kind of damage experienced earlier when the coax loop got caught on the tower.

SWR was good on all bands after it was all connected up, however the LDG tuner doesn't appear to be working. After we resolve that, all the RG-213 single-shielded coax that connects the surge arrestors on the roof to the radio room will be replaced using the recently purchased double-shielded LMR-400. We hope to have everything working properly prior to the Feb 4th BC QSO Party. A temporary space heater was installed in the radio room until the City of Surrey gets the HVAC system fully working on the lower floor but we are still trying to get them to assist in diagnosing the source of wide spectrum RF noise experienced in the radio room.

More photos next page...

~ John VA7XB



ITURHFProp Propagation Prediction Website

An introduction to G4FKH's new propagation predictions tool.

RadCom readers may be aware of Gwyn G4FKH's new HF propagation prediction project, software and website based on a new prediction engine.

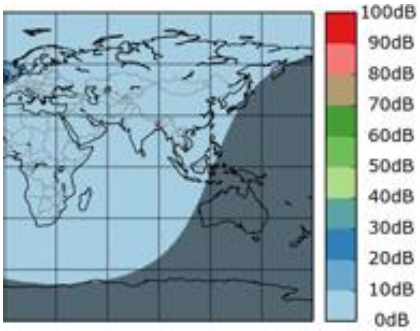
The project's aim is to produce a propagation prediction tool that uses the new ITU-produced program ITURHFProp, which has been shown to be more accurate than older prediction methods.

Another aim was to produce something that was new to the web and different from the normal prediction packages. With the assistance of programmer James A. Watson, HZ1JW the first phase of the project was achieved. He produced a very readable and easy-to-understand interface. Mark Lawrence, G0WMT volunteered to step in and has completed a sophisticated yet easy to use, set of point-to-point predictions.

To start the application visit http://www.predtest.uk/

User information

The landing page shows a world map with signal to noise ratio (SNR) coverage from the UK for a given HF band at a given time. Reliability and S-Meter output is available simply by choosing the desired element from the drop-down box.



There are drop-down boxes for the time and frequency, the starting prediction time will always be the current hour and the frequency will be 14.0MHz. You can then easily select a different band or time. Point-to-point (P2P) predictions are available from the menu at the top of the page.

Filling out the form and clicking the Create Prediction button will start the process—a choice of output is available from the menu.

New innovative features have been used to display the prediction engine output—e.g. hovering the mouse in the plot area shows static data for a particular hour. A distinct feature is the ability to change the colour scheme on the output plots; this was provided to cater for a user with a particular preference or need.

While the tool is thought to be intuitive, explanations are available on the Usage Tips page. Also available, under Credits, is information for those studying propagation.

~ RSGB

The SEPAR Report

Roger Andrews VA7VH

"...the most likely disaster event to occur in Surrey - a deep-freeze with power outages."

Well, the snow has gone. Almost! As of today, January 24, there's still several lawns and fields with snow, quite a few small snow banks over a foot high and several massive snowbanks 5 feet high where I live in Fraser Heights. The snow was piled high to get it off the streets. Those piles will be there into February. Now that things have warmed up it's probably safe to say that we didn't need to deal with any winter disaster. No fulfillment of what the City of Surrey Emergency Plan calls the most likely disaster event to occur in Surrey - a deep-freeze with power outages. And it's a wonderful thing we haven't had something like that occur - and hopefully never will. We are back to our normal wet, West Coast weather. While a bit of an inconvenience for some, I felt that it was nice to have a fourth season for a change. But even I grew weary of snow at about the time that it began to leave us.

The winter we have just had should give us pause to consider the possibilities that exist for disasters caused by changing weather patterns. This year, even before our winter had officially started, we experienced a fair bit of snow. Well more than we are used to having. In fact, it was enough that the roof on the New Westminster Arenex collapsed. We had some wind and power outages. Then as it became warmer, we were warned about flooding that could have come with the snow melt and from all of the predicted rain. Other than a bit of inconvenience, and piles of snow reminiscent of winter in the streets of Montreal, we came out of it all pretty much unscathed. With all the unexpectedly odd weather, nothing really bad happened this winter.

I come from a career (Paramedic) that deals with people every minute of everyday who didn't expect a bad thing to happen. Yet if I was standing over them, it did happen. So when something happens to all of us at once, such as an unexpected winter, (which under the right circumstances could become disastrous) it reminds me how mentally ambushed people feel when they don't have the time to prepare for that disruptive event like a personal or health disaster. Natural disasters, on the other hand, are

almost always something we can all prepare for. It won't make the disruptive event go away, but it will make it at least survivable and in many cases, more comfortable. Bad things don't always happen somewhere else.

SEPAR trains monthly on the procedures and equipment which would we used in the event of an emergency. SEPAR is a joint amateur radio / City of Surrey program. If you would like to learn more or get involved with SEPAR please contact Roger (va7vh@rezgas.com).

Every Tuesday evening at 1930 hrs (7:30pm PDT) we start a ½ hour NET on a local repeater provided by the Surrey Amateur Radio Club (SARC) on 147.360 MHz +600kHz and a tone of 110.9. There may be a simplex test or a test NTS message transmitted during the NET at the Net controllers discretion. This is an excellent opportunity to practice sending and receiving this form of messaging. Besides, it adds a little spice to the regular check-ins on the net.

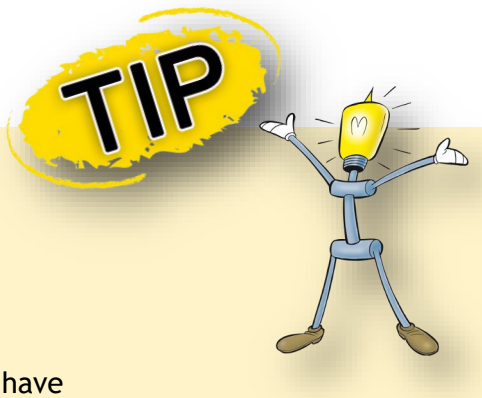
Please join us. NTS Radiograms can be found on the SEPAR website http://separ.comm.sfu.ca

Thursday nights at 19:30 hours, we only provide Simplex operations starting on frequency 146.550 and changing frequencies and bands for further signal checking. During these tests, we encourage those with mobile or hand held capabilities to try different locations each time to become more knowledgeable as to what to expect in a real disaster. We are unable to predict where we will be located when we are needed. Additional training sessions and practice exercises are scheduled throughout the year including participation with other departments and agencies.

73 to all,

~ Roger Andrews VA7VH

SEPAR trains monthly on the procedures and equipment which would we used in the event of an emergency.

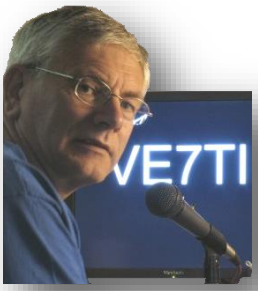


Logbook Of The World Changes

ARRL Logbook of The World (LoTW) no longer will accept contacts that have been digitally signed by versions of TQSL earlier than version 2.0.

Users of earlier versions are encouraged to upgrade as soon as possible, as older TQSL versions contain uncorrected defects and display inaccurate error messages. The current versions of TQSL for Windows, OS X, and Linux are available online.

To date, LoTW has confirmed some 135 million contacts for its 90,000 users.



Back to Basics

John Schouten VE7TI

From The Basic Question Bank

Q– Codes

QRM—man-made Interference

QRN—Natural Interference

B-001-025-002

In the event of interference to a neighbour's television receiver, according to EMCAB-2 (Electromagnetic Compatibility Advisory Bulletin) it will be deemed that a radio amateur's transmission is the cause of the problem if the field strength:

A. on the neighbour's premises is above Industry Canada's specified immunity criteria

B. near the TV is below Industry Canada's specified immunity criteria

C. at the transmitting location is below the radio amateur's maximum allowable transmitter power

D. at the transmitting location is above the radio amateur's maximum allowable transmitter power

There are several questions in the Basic Question Bank dealing with so-called “Harmful Interference”. It is very common, most frequently in HF transceivers, to have interference creep into your, or a neighbor's entertainment system. In some cases, it is a baby monitor, fluorescent light or some other device that causes interference with your equipment. The article beginning on page 14 is very detailed in resolving interference issues so I won’t delve into the same subject in detail here.

Basically, electromagnetic interference (EMI), also called radio-frequency interference (RFI) when in the radio frequency spectrum, is a disturbance generated by an external source that affects an electrical circuit by electromagnetic induction, electrostatic coupling, or conduction. The disturbance may degrade the performance of the circuit or even stop it from functioning. In the case of a data path, these effects can range from an increase in error rate to a total loss of the data. Both man-made and natural sources generate changing electrical currents and voltages that can cause EMI: baby monitors, automobile ignition systems, cell phones, thunderstorms, a bad power line connection on an outside pole, the Sun, and the Northern Lights are all common sources. Some of these, like the sun and northern lights we can do little about. Most can be resolved, or at least reduced by some detective work and appropriate filtering. EMI frequently affects AM radios, this is why they are also good for EMI hunting. It can also affect cell phones, FM radios, and televisions. EMI can be used intentionally for radio jamming, as in electronic warfare.

Electromagnetic interference can be categorized as follows:

- Narrowband EMI or RFI interference typically emanates from intended

transmissions, such as radio and TV stations or cell phones.

- Broadband EMI or RFI interference is unintentional radiation from sources such as electric power transmission lines.

Interference tends to be more troublesome with older radio technologies such as analogue amplitude modulation (AM), which have no way of distinguishing unwanted in-band signals from the intended signal, and the omnidirectional antennas used with broadcast systems.

The International Special Committee for Radio Interference or CISPR (French acronym for "Comité International Spécial des Perturbations Radioélectriques"), which is a committee of the International Electrotechnical Commission (IEC) sets international standards for radiated and conducted electromagnetic interference. These are civilian standards for domestic, commercial, industrial and automotive sectors. These standards form the basis of other national or regional standards, most notably the European Norms (EN) written by CENELEC (European committee for electro-technical standardization). US organizations include the Institute of Electrical and Electronics Engineers (IEEE), the American National Standards Institute (ANSI), and the US Military (MILSTD). Industry Canada's Radio Standard Specifications (RSSs) describe the various technical requirements and processes to be followed when demonstrating compliance of radio apparatus that is used for radiocommunication other than broadcasting. Specific immunity criteria are published by the Ministry of Innovation, Science and Economic Development (formerly known as Industry Canada).

Where the Department determines that a product causes or is likely to cause interference to radiocommunication, or suffer from or are likely to suffer from adverse effects of electromagnetic energy, the Department shall give notice of this determination to persons who are likely to be affected by it. No person shall manufacture, import, distribute, lease, offer for sale, sell, install or use equipment for which such a notice has been given.

If the Department determines that a unit of equipment causes or suffers from interference or adverse effects of electromagnetic energy, the Department may order the person(s) in possession or control of the equipment to cease or modify operation of the equipment until such time as it can operate without causing or being affected by such interference or such adverse effects.

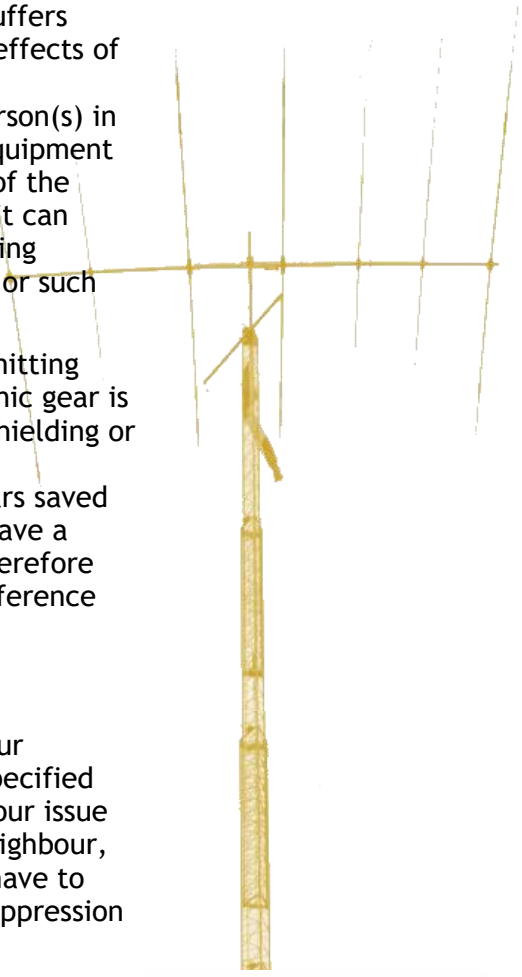
This applies not only to transmitting equipment. Consumer electronic gear is generally woefully lacking is shielding or other interference resolving components. A couple of dollars saved on each TV, stereo, etc. can save a manufacturer millions. It is therefore not surprising that many interference related complaints arise from inadequacies with this type of electronic product.

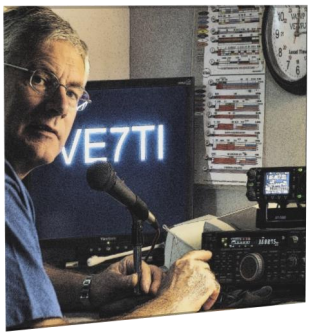
Therefore, if your signal at your neighbour's TV is above the specified immunity criteria, it will be your issue to resolve. If it is not, your neighbour, perhaps with your help, may have to invest in some interference suppression components.

The correct answer to our question therefore is **(A) on the neighbour's premises is above Industry Canada's specified immunity criteria**

~ John VE7TI

"…the Department may order the person(s) in possession or control of the equipment to cease or modify operation…"





QRM

...from the Editor's Shack

Do you have a photo or bit of club news to share?
An Interesting link?

Something to sell or something you are looking for?
eMail it to SARCcommunicator @ outlook.com for inclusion in this column.

HF and Contesting Incentive Program!

To assist you getting to the 'right' person, we have some new contact addresses:

president@ve7sar.net
vicepresident@ve7sar.net
secretary@ve7sar.net
treasurer@ve7sar.net
communicator@ve7sar.net
webmaster@ve7sar.net
repeater@ve7sar.net
membership@ve7sar.net
directors@ve7sar.net

In an effort to encourage members to be more active on HF and participate in contesting the SARC board of directors has decided to offer an incentive.

Select contests will be suggested and discussed ahead of time. SARC members that have submitted logs of at least 25 QSOs (a reasonably obtainable number) will be put into a draw at an upcoming general meeting for a gift card. Gift cards may be for Tim Horton's, Starbucks, etc. Either individual or SARC club team participation counts but you must be the operator for that minimum to qualify. The dollar value and number of cards will depend on the level of participation of the membership. The more that participate the more cards we will draw for.

We would like to see the membership actively encouraging and supporting fellow members in these activities and the use of club radios and equipment at the OTC. The hope is to have the SARC flag better represented in these select contests and to encourage more members to become active and to know how to operate HF radios and equipment. Of course the more comfortable one is with both HF and VHF+ radios the better they will be able to operate them in a real emergency. And it is fun!

Those that would like to learn more about contesting and/or HF can contact any of the directors. And those without their own equipment are more than welcome to come and learn either during or outside a contest at the OTC.

~ Sheldon VA7XNL

Page 13—News You Can Lose

The Lighter Side of Amateur Radio

Trump Promises Greatest Propagation Ever

By K5PO, on the scene

NEWINGSTEAD, VT – Newly inaugurated President Trump wasted no time reaching out to members of the amateur radio community. On Monday, President Trump was the keynote speaker at a banquet co-sponsored by radio equipment manufacturer Peanut Whistle Transmitters Inc. and the National Radio Retransmission Legion (NRRL). Trump was a surprise late addition to the speaker lineup for the annual two-day "Radio in America" gathering at the NRRL's headquarters.

"We invited him as a courtesy, but honestly didn't expect he'd show up. I assume he's a very busy man," said NRRL president Bob Gilligan. "But then I received a call yesterday from the Trump administration who informed us that the President would most certainly meet with such great communicators. We were shocked! To fit in the President we had to cancel Wiley Roger's planned panel discussion on his hypothesis that blue-colored wire has increased his DX performance."

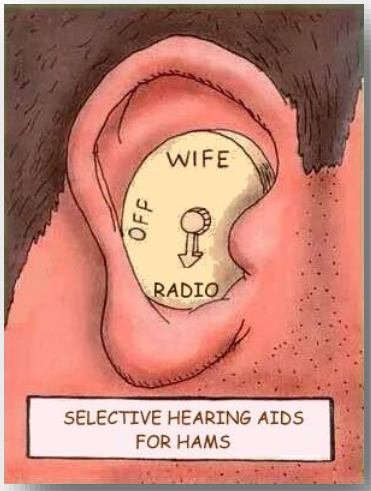
President Trump's speech to the 27 attendees lasted a little over three hours and ranged in topics from installing antennas atop Trump Tower to the low sunspot cycle.

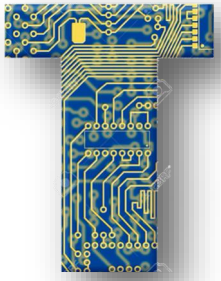
When Peanut Whistle Transmitter Company's Chief Counsel asked Trump if he had any plans to improve propagation as we approach a new low in the sunspot cycle, President Trump had no reservations in stating, "My administration will bring amazing propagation to all of you… really, really amazing. To all American hams. It'll be the best. The best propagation. So big. They'll be so much DX, we'll be exporting it to other counties. You've never seen propagation like the propagation we'll have."

Trump closed the banquet with the announcement that he'll immediately sign an executive order to increase sunspot counts to 1000 within the next 100 days.

Ham Hijinks inquired with NOAA Space Weather Scientist Ramish Pental about how the administration would go about this executive order. He quickly replied, "It literally makes zero sense. I have no idea whatsoever."

~ Ham Hijinks





Tech Topics

Jim Brown K9YC

Build Contesting Scores by Killing Receive Noise

I've been very pleasantly surprised how much I can work when the station on the other end can hear well.

As a west coast contester, I'm not competitive in DX contests, so I often operate QRP in pursuit of the personal challenge of 5BDXCC with 5W. I've been very pleasantly surprised how much I can work when the station on the other end can hear well. The problem is that many stations with big transmitted signals have poor receive capability. When we can't hear well, it's easy to turn into a CQ machine, and miss a lot of QSOs. This article is about tracking down and killing the noise that is killing our RX and costing us QSOs! We'll begin by talking about the three basic kinds of noise, then how to identify them by type, how to track them down, and how to suppress the noise they generate.

How Much Noise is Normal? The noise we hear when the band is open is propagated like any other signal from a distant QTH. A good rule of thumb is that for a reasonably quiet QTH, noise on the HF bands should increase by at least 10 dB when the band opens. A QTH inside most cities and suburbs may be a lot noisier, but increasing the observed difference at your QTH will help you hear more of the weaker stations on the band. And even in a quiet QTH, the noise should drop to the level of its own circuit noise when we disconnect our antenna from the radio. If this doesn't happen, either the antenna is performing poorly on that band or the radio needs a preamp.

To evaluate noise levels, and the effectiveness of our attempts at noise reduction, we need some reasonably accurate and reproducible method of measuring it. That can be the S-meter in our radio, or a spectrum display or analyzer, but whatever we use, it must provide readings that are consistent from one setup to the next on the same band.

Most S-Meters Are Inaccurate they may be calibrated at S9, but the difference between S-units typically varies from 5 dB near S9 to 3 dB at S6 and below, and the "dB over S9" may be equally inaccurate. Calibration of the meter in the Elecraft K3 and K3S is much better than average, and can be user-calibrated from the "tech" menu with a calibrated signal source. Calibration also carries over to the P3 spectrum display.

Noise on our ham bands is of three basic types. The one we're most familiar with is *impulse noise*, most often generated by defective equipment in the *mains power system* and by *lightning*. In the power system, impulse noise is generated by something arcing, typically a defective insulator, transformer, or a broken conductor that's intermittent. *Defective neon signs* are another source of impulse noise. WX5L notes that *forced air attic ventilators thermostats* can create impulse noise as they age especially if they are near

the fan as it vibrates the surrounding area.

The ordinary "static" we hear from the AM broadcast band up to about 40M is impulse noise – lightning from millions of sources, propagated like any other radio wave, from discharges near and far. The loudest crashes are nearby; the more distant lightning blends together to form a more uniform din. Impulse noise is quite broadband, and consists of the infinite harmonics of the impulse.

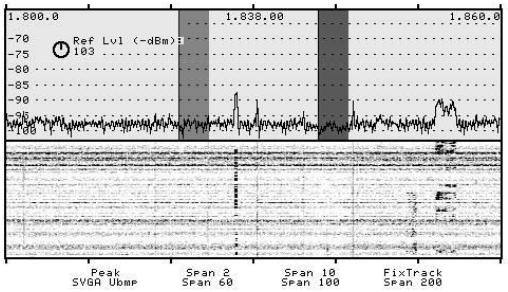


Fig 1 – Static Crashes On 160M

The strength of impulse noise tends to fall off both with increasing frequency and in increasing distance from the source. The strength of power line noise (and even whether it is present at all) also varies with weather, especially humidity.

In Fig 1, the horizontal lines in the waterfall are static crashes, the vertical ones are signals. The one around 1828 kHz is a CW signal, the weak ones around 1831 and 1839 kHz are probably electronic noise, and there's an LSB signal around 1854 kHz.

Electronically Generated Noise is the second basic type, and in recent years have become the dominant sources for most of us. Electronic noise sources include anything with a microprocessor, any digital electronics, variable-speed motor controllers, DC-AC inverters, charge controllers in solar power systems, and switch-mode power supplies (SMPS). SMPS are used as the low voltage

power supply (mostly in the range of 5 – 24VDC) for cable TV decoders, the electronics in home entertainment systems, laptops, phones, and low voltage lighting. These power supplies often come in the form of wall warts and cord lumps that power all sorts of electronics, and that charge batteries for everything from mobility scooters and power tools to cell phones. They may also be built into the electronics themselves – TV sets, computers, refrigerators – virtually anything that plugs into the 120VAC line. The charge controllers and DC to AC inverters that are part of solar power systems can generate high noise levels if poorly designed and/or poorly installed. We'll discuss solar power systems later on.

The average home in the developed world typically has at least thirty such potential noise sources (and often more), and we hear not only our own but those in our neighbors' homes. The noise produced by these sources is mostly radiated by cables attached to the sources, although in larger appliances like refrigerators and the variable speed motors in a furnace, wiring internal to the source may radiate the trash. It's simple antenna action – by virtue of poor design, the noise source leaks common mode current onto external cables and differential current onto internal wiring, both of which become antennas.

Signal Leakage from equipment or wiring is a third type of interference. Fig 2 shows leakage from a VDSL modem from about 3.7 – 5 MHz that strongly affects the 75M band. With help from W0QE, W0IVJ captured this spectral plot from an SDR in his Toyota as he drove around his neighborhood. The broad hump of noise is from the modem – the spikes are from an SMPS

The average home in the developed world typically has at least thirty such potential noise sources

in his Toyota, as well as from other noise sources in the neighborhood. The spike at 5 MHz is WWV's carrier. This RFI will be heard as noise or hash. Tom recorded this as a video, which he has posted at https://www.youtube.com/watch?v=HIGMmEgzhv0&feature=youtu.be There's more about this form of RFI later in this document where we address issues and solutions with specific product types.

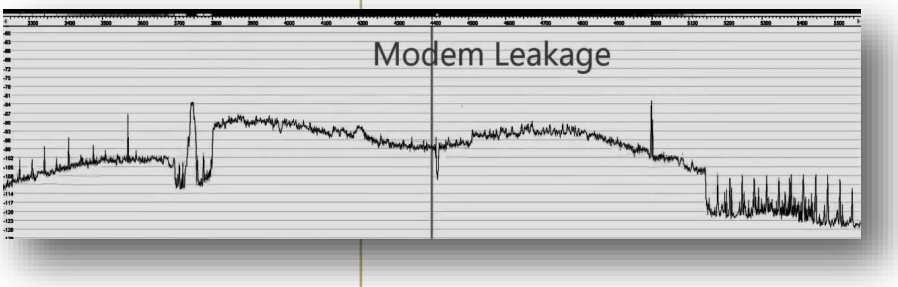


Fig 2 -VDSL/Cable Modem 3.2MHz - 5.6 MHz, 3dB/div

Optimize Your Station First

There are some things we can do with our stations, and that we should do before chasing noise sources. We can

1) use antenna directivity to point away from noise and toward the stations we want to work;

2) locate antennas as far as practical from noise sources – height helps with this, and generally makes them better DX antennas;

3) use an effective ferrite common mode choke at the feedpoint of every antenna;

4) horizontal antennas are usually (but not always) quieter than vertical antennas;

5) avoid off-center-fed antennas (which are inherently noisy) and open-wire-fed antennas, neither of which can be effectively choked, and

6) implement proper bonding and grounding within your station and throughout your home. [I'll be writing about grounding and bonding in the future; in the meantime, see http://k9yc.com/GroundingAndAudio.pdf and W9RE's "Station Tending" column from Sept/Oct 2015 NCJ.]

Use a common mode choke at the feedpoint of every receive (and transmit) antenna to prevent the antenna feedline from becoming part of the antenna. This reduces receive noise because

1) our antennas are usually up in the air and more distant from noise sources, so they receive less noise by virtue of their distance from sources in our own home and those of our neighbors; and

2) antennas reject some noise by virtue of their directivity. An effective choke on the feedline at the feedpoint also prevents signals picked up on the feedline from entering the cable as differential mode signals, and from filling in the nulls of the antenna's directional pattern. For general and specific guidelines for feedline chokes see http://k9yc.com/RFI-Ham.pdf and the companion Power Point slides http://k9yc.com/CoaxChokesPPT.pdf

There are some things we can do with our stations, and that we should do before chasing noise sources.

Locating Noise Sources

Common Mode and Differential Mode Transmission: Most RF noise is transmitted as a *Common Mode* signal on wiring connected to the source – that is, the wiring radiates because noise current is flowing on a coax shield, or in the same direction on all conductors. It's simple antenna action. *Differential Mode* transmission is a voltage *between* the wires that make up the path, with current on the pair flowing in opposition. Very little RFI is the result of differential mode transmission, so filters are rarely of any use. If a filter is used, it must be carefully designed so that it does not degrade transmission of the desired signal.

Power Line Noise Current (and the current from arcing neon signs) flows on wires connected to the arcing source, and is radiated by those conductors by simple antenna action. Low frequency components of the noise use very long lengths of those conductors, while higher frequency components use the parts of the conductors that are very close to the source. Those low frequency components can travel pretty long distances – it's not at all uncommon for hams in rural areas to hear arcing power lines 10-20 miles away on the lower ham bands.

It's quite difficult to locate the source of power line noise at low frequencies, both because the wires radiating those components them are so long, and also because the noise may travel along the lines as a differential signal, creating peaks and nulls in voltage and current (power lines are transmission lines at RF as well at power frequencies). The key to locating the source of power line noise and other impulse noise is to search for it at VHF and UHF. I own several tools that work well for this. If the source is within walking distance, a handheld AM RX that can tune to VHF and/or UHF is a big help. I have two – a Kenwood TH-F6A talkie, and a Tecsun PL660. The Tecsun PL660 and PL880 receive AM on the MF and LF AM bands, and from just above the 160M band to nearly 30 MHz. The PL660 also receives AM on the 118-137 MHz aviation band, while the PL880 does not. The PL880 got a positive review from ARRL Labs a few years back. The Tecsun radios use DSP technology, and happen to be excellent AM and FM receivers for both SWL and entertainment. The TH-F6A can receive AM from just above the audio spectrum to 1.3 GHz (although it's not very sensitive below VHF), and maintains maximum sensitivity to about 550 MHz. If the source is beyond easy walking distance, a VHF/UHF FM mobile rig that also tunes AM is a great tool. My current favorite is a Kenwood TM-V71A.

The two Kenwood rigs have many memories that can be programmed either manually or from an accessory computer program. In addition to repeater frequencies, I've programmed my TH-F6A and TM-V71A for AM on 160, 200, 300, 400 MHz, and that highest frequency of maximum sensitivity around 550 MHz. When searching for the source of power line noise, I drive around tuned to 160 MHz looking for the signal; when I find it, I switch to higher frequencies as it gets stronger. When I'm hearing it peak at 550 MHz, I get out of the car with the talkie tuned to that frequency.

Foxhunts held by my Chicago area ham club taught me that placing a talkie with a rubber duck close to my chest would block signals from behind me, making it a simple directional antenna. This makes it possible to locate the source by direction, then move toward it. We could get even more directivity by attaching a small 440 MHz Yagi and setting the radio for AM around 440 MHz.

Ideally, we want to identify the source location as precisely as possible before calling the power company. By all means, get an address, intersection, or lat/long coordinates, even the identifying numbers on a pole nearby. (Record ALL of the numbers on the pole – every service on the pole will assign it a different ID. The power company will know which one is theirs.) The closer we can get the power company's investigating team to the source, the more likely it is to be found and fixed (and the more your expertise will be respected). ARRL can provide advice on contacting the power company, and what to do if things don't go as well as you hope. Power companies generally respond fairly well to find the source, because it often points to a potentially dangerous condition or a likely point of failure. But here in California, those same power companies have a poor record of fixing problems that only

Ideally, we want to identify the source location as precisely as possible before calling the power company.

cause noise; Garry, NI6T, has learned that it's because administrators of the teams that fix things are rewarded if they have spent less of their budget at the end of a year.

At least one local ham, an attorney, has had good results contacting the state agency that regulates his local power company when this has occurred.

Fig 3 – Some RFI Hunting Tools▫ARRL has great resources for understanding and dealing with Power-Line Noise. Start with this well written and comprehensive webpage. http://www.arrl.org/power-line-noise

Electronic Noise Sources: Just as with power line noise, our first task is to identify the noise as electronically generated, zero in on the source, and once we've found it, apply suppression to kill it. Electronic noise sources, (except for those sources that generate arcing), are some form of square wave. Square waves produced by Switch-Mode Power Supplies (SMPS) are usually in the range of 10-30 kHz, and they are not stable in frequency. They are free-running oscillators, and, to get around FCC Rules for radiated noise at a single frequency, are frequency-modulated by random noise. This produces the characteristic carriers spaced 20-60 kHz apart (2X the frequency of the square wave), each carrier surrounded by sidebands of noise, that drift up and down the band as they warm up, or as their load condition changes. When we hear (or see on our rig's spectrum display) these drifting carriers surrounded by humps of noise, we know that the culprit is some form of switching power supply or DC to AC inverter. If the carriers don't move, the source is most likely circuitry linked to the clock for a microprocessor or other digital electronics.

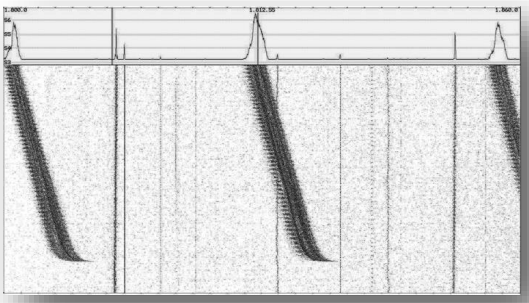


Fig 4 – Spectrum of a Switch Mode Power Supply

Fig 4 shows the classic spectral signature of a Switch-Mode power supply (SMPS), as well as eleven signals that are likely generated by a stable clock for digital electronics. This screen shot shows the lower 60 kHz of the 160M band; the total height (duration) of the waterfall displays about 165 seconds. The noise source is an SMPS in my shack that was turned on (about 30 seconds above the bottom of the waterfall). The repetition rate of this SMPS is about 14 kHz, half the spacing between frequency peaks. The straight vertical lines in the waterfall are electronic noise produced by digital equipment, probably from several different sources. At least one, the weak signal just to the right of the pulsed signal around 1840 kHz, is drifting down in frequency at a much slower rate, so it is also an SMPS. An SMPS sounds like a gurgly carrier surrounded by noise. If it's weak, we'll hear only the carrier.

Electronically generated noise is generally *not* broadband, but rather is stronger in some frequency ranges than others. The 33V power supplies that SteppIR supplied for their controllers when long cable runs would be used generated extremely strong RFI on the higher HF bands, especially on 12M. Even with heroic efforts I was unable to choke it effectively, and I eventually replaced it with a home brew linear supply.

Wired Ethernet cables radiate what sounds like White noise at VHF, and individual carriers in the HF and low VHF spectrum. Those carriers are stable in frequency and synchronized to the Ethernet switch, but the tolerance on frequency is wide enough that you'll typically hear your own and your neighbors' at slightly different frequencies centered around 14,030 kHz, 21,052 kHz, the low ends of 10M and 6M, and a few frequencies on 30M. These are only some of the carriers, but I'm a CW guy, so they're the ones I've identified. I don't know of any Ethernet noise components below 30M.

When chasing electronic noise, it's always best to start at home. In doing so, we lower our noise level so that we can hear our neighbors' noise, and we also learn to identify the sources and sup- press them. A good start is to first kill power to your home while listening to your rig while it's running on batteries. Most rigs draw only 1-2A on receive, so a 12V battery of relatively modest capacity is sufficient for short listening periods. There are a couple of bear traps though; first, we need power for accessories like antenna switching that keep our rig connected to the desired antenna(s). This can be tricky in some stations. Second, we must make sure that a UPS doesn't keep noisy equipment going when we think it's turned off. For most of us, that means unplugging and putting to sleep laptops and tablets, and temporarily shutting down other computers. The noise that remains with our own home shut down is outside our home. [For this series of tests, it's best to listen on antennas close to the house; if your primary antennas are more distant, try rigging a random wire near the house for this test.]

The next step is to turn power back on, one circuit at a time, and carefully listen to all bands and all antennas for any noise that wasn't there with the power off. Each time a new source appears, identify and record what's connected to the circuit that just turned on, make notes of what's connected to it, and then using our portable radio as a signal probe to see if we hear noise. Alternatively, turn off each piece of equipment on that circuit and listen for the noise to disappear. As you identify each source, suppress it, before moving on to the next one.

This process goes a lot faster and works a lot better with another ham who either flips breakers and turns equipment on and off or listens in the shack as you do the power switching, using VHF radios to communicate. While doing this, consider that most SMPS drift as they warm up, so will have shifted in frequency from when you turned them off, so it may be necessary to tune around to find them. A spectrum display is a big help here, and should be set for the widest practical frequency width.

The ARRL website lists some common home appliances that can be sources of RF noise. Being on this list doesn't mean that it *will* cause RFI, but that *some* appliances of its type have been found to generate RFI. The list includes Electric Blankets, Heating Pads, Clean Air Machines (table top and furnace type) Aquarium Heaters,

Next running of the BCQP: 1600z February 4 to 0400z February 5, 2017

Suggested frequencies:

Band	Freq. (Khz)	Band	Freq. (Khz)
160M CW	1815	160M PH	1845
80M CW *	3585	80M PH	3850
40M CW *	7035	40M PH	7230
20M CW *	14035	20M PH	14250
15M CW	21035	15M PH	21300
10M CW	28035	10M PH	28490

* CW after 0000z consider 3570, 7070 and 14050 (due to NA Sprint CW activity)

Portable radios that use a ferrite loopstick antenna make a much more sensitive probe

Furnaces and Furnace Control Circuits, Refrigerators, Amplified Antennas, Door Bell Transformers, Light Dimmers, Ceiling Light Fixtures, Low Energy Compact (screw-in) Fluorescent Lights, Touch Control Lamps, and Photocells.

Peeling the Onion: All of us here in the real world hear noise from many sources, the strongest ones obscuring the weaker ones. Finding and killing RFI is a many-layered process, like peeling an onion – when we kill those strong ones, we can go after the weaker ones.

Tools For Identifying Sources: W6GJB reports that an MFJ-805 current probe was helpful in finding RF noise currents on cables. The unit is quite simple, and can easily be home-brewed for a lot less than the $100 cost of the MFJ. It's simply a coupling coil wound on a clamp-on ferrite core that is temporarily clamped around the cable we want to check for noise; the coil feeds a diode detector, filter capacitor, DC meter, and series pot to set meter sensitivity. These applications notes describe several good ways to do it.

http://www.w8ji.com/building_a_current_meter.htm

http://www.ifwtech.co.uk/g3sek/clamp-on/clamp-on.htm

http://www.interferencetechnology.com/the-hf-current-probe-theory-and-application/

Portable radios that use a ferrite loopstick antenna make a much more sensitive probe for common mode current at frequencies where the radio uses the loopstick (below 10 MHz for the TH-F6A). Simply hold the loopstick perpendicular to the cable you're probing. At higher frequencies, use the rubber duck as an RF probe. A menu selection also allows the SMA connector to be used at any frequency, and the Tecsun PL660 has an antenna input in the form of a 1/8-in TRS jack.

How Noise is Coupled Into and Out of Equipment and Systems

Noise Is Conducted From Equipment Onto Cables when cable shields are not bonded to a shielding enclosure at the point of entry, or when unshielded cables are not properly bypassed to the shielding enclosure. The failure to properly terminate shields was first addressed by Neil Muncy, ex-W3WJE (SK) in a landmark paper first published in the Journal of the Audio Engineering Society in June 1995. He called it "The Pin One Problem" because Pin 1 of the XL connectors used for microphones and other audio interconnections is the shield contact. Pin One Problems are a primary cause of RFI, providing a path both into and out of equipment for hum, buzz, and RF noise.

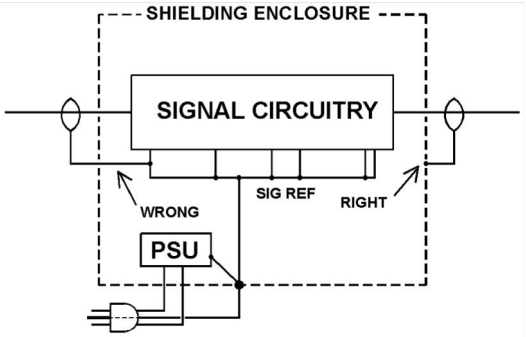


Fig 5a

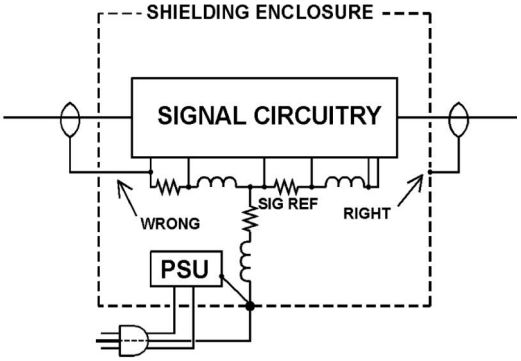


Fig 5b

Fig 5a illustrates "*The Pin One Problem*" and Fig 5b shows how it

couples shield current into active circuitry. Shield current on the output cable flows to the shielding enclosure and from there to the power system equipment ground conductor (the "green wire"). All noise current stays outside the equipment, so it can't couple to the equipment.

Shield current on the input cable flows to a return trace on the circuit board on a path at the whim of the PC board layout artist, and eventually gets to the same power system ground conductor. As it traverses the return trace(s), IZ voltage drops are established across the R and L of the path, and the potential difference is injected at the input of one or more active stages where it is amplified (and, if it's RF, is detected by diode action at a stage input).

Pin One Problems on both input and output cables cause hum, buzz, and RFI, and signal flow logic cannot be used to find them, because layout of the signal return path, which often has nothing to do with the signal path, determines where noise is injected. *And because the cable shield connects to some random point inside the unit, any noise present at that point will couple onto the cable shield and be radiated by the shield. This is a major cause of RFI from equipment*.

Because of the way printed circuit boards are manufactured and mounted in equipment, it is rarely practical to correct Pin One Problems without major surgery that is likely to turn into a major engineering project to fix circuit instability. And, of course, we don't want to do anything that affects a product warranty, nor do we want to open up our neighbor's TV set, computer, or WiFi router. The far better solution is to kill the current on the cable shield, both

1) by choking it with a suitable ferrite choke, and

2) by shunting the current away from it by bonding all equipment chassis together and to the ground system for the shack and the building.

Magnetic Field Coupling of noise is proportional to the strength of the current, the area of the loop in which the current flows, and the loop area of the receiving circuit. Loop area is minimized when forward and return conductors are run closely in parallel, and is increased when conductors are spread out – for example, at battery terminals of a solar power system, or to circulate through multiple batteries wired in series. Magnetic field coupling is a primary coupling mechanism in DC power circuits, like solar power systems and variable speed motor control systems.

Noise Can Be Radiated By the Equipment Itself if circuit layout is poor and the unit is unshielded or poorly shielded. One common design error is wiring that forms an antenna or a current loop with a large loop area. A common design error producing this result is breaking the "ground" layer on a multi-layer printed circuit board. At radio frequencies, the return current for a trace on a circuit board with a "ground" layer will be confined to a narrow area directly underneath the trace; the trace and the "ground" layer form a transmission line, so there can be no radiation from that circuit trace. All of that breaks down if the "ground" layer is broken under the trace – it's like any other coax with an open shield! When this happens, the return current takes whatever unintended path is available, and the result is both an antenna and strong magnetic coupling.

The only known fixes for such equipment are:

1) rewire/rebuild the equipment to eliminate the current loops;

2) completely shield it, bypassing all cables that penetrate the shield to the shielding enclosure;

Part 2 of this article in the March Communicator

Over the years, I've solved many RFI issues with home entertainment systems by replacing the zip cord used for loudspeaker wiring with twisted pair

3) give it "the bucket treatment." [The Bucket Treatment: Find a bucket large enough to hold the defective device, fill it with water, put the defective equipment in twice, and take it out once.]

Twisted Pair is far superior to parallel conductor cable (zip cord) in minimizing noise coupling. All noise sensitive circuits and all circuits carrying noise currents, especially those carrying large currents, should utilize twisted pair. It's easy to make your own twisted pair. All the DC wiring for my small solar system uses #10-2 THHN that I twist by cutting equal lengths of black and white stranded #10, clamping one end of both conductors in a bench vise and twisting them with a portable drill motor. Over the years, I've solved many RFI issues with home entertainment systems by replacing the zip cord used for loudspeaker wiring with twisted pair.

Suppressing Electronic Noise: Now that we've identified a source and know how noise is coupled, it's time to suppress it. There are two good ways to skin this particular cat. Often it's easiest to replace the noisy component with one that isn't noisy. I've scoured flea markets and second hand stores to put together a large box of old wall warts for equipment that I no longer own. They're bigger and heavier than a modern switch-mode wall wart, because they contain a linear power supply – that is, a simple transformer followed by a rectifier and a filter capacitor. They're a bit less efficient, but they're dead quiet!

Replace The SMPS: There are (at least) two good ways to utilize these old linear supplies. First, we must determine their open circuit voltage and their voltage under load. Next, we must determine the voltage and current needed by the electronics that it must power. When we find a linear supply that matches the equipment in question, we simply cut the cables for the two supplies and splice the linear supply to the cable that feeds the equipment. For greater flexibility, I install a Red/Black Power Pole connector pair s on cables from the linear power supply and the equipment.

Float-Charge a Lead Acid Battery: A second technique I've used extensively is to obtain a fairly small ordinary sealed lead-acid (SLA) battery of the voltage used by the equipment and use a linear wall wart to float-charge it. I use Power Pole connectors universally for DC power in my home and shack. It's easy to make a few parallel adapters to connect the charger and several pieces of equipment to a single battery. In my home, one such setup powers my cable modem and wi-fi router.

[El Nino rains caused us to lose power for 18 hours during ARRL DX SSB; the internet router and WiFi system was still running when power was restored!] Another float-charged battery powers four 12V accessories in my home entertainment system (a cable box, a Roku box, a DVD player, an Apple TV, and a "trucker's" FM modulator that feed an internet "radio" around my home and yard). I have three more small float-charged batteries running Samsung computer monitors that run on 12-14VDC, and another with a 6V battery running an "internet radio" for which the specified voltage is 7.5V.

When implementing this strategy, carefully select a supply that provides enough current to run the equipment without over-charging the battery. SLA batteries will generally accept a charge less than their 10-hour discharge current without degradation. These linear supplies may or may not include a capacitor input filter, and their DC voltage will vary under load. Always measure battery voltage and charging current after the battery is charged and the equipment is running. A silicon diode in series with the

charger will reduce charging voltage by 0.6 – 0.7 V; one or more diodes can prevent overcharging. Over-charging a battery can ruin it, so make sure that charging current is no greater than battery's rated 10-hour discharge current. I find the inline Watts Up digital meter (Fig 6) to be a convenient way to monitor voltage and current. One caution though – it measures current in the negative lead, so can give wrong answers if there' a return path through interconnected equipment. A better choice is the more expensive HamSource EZMeter, which meters in the positive lead.

Likewise, in the shack, all the rigs and their 12V accessories run from a big 12V battery that is float charged by a 20A supply and, during the summer months, four solar panels. Equipment powered from this system includes three more Samsung monitors, antenna switching, etc. Each one of these setups functions as a simple UPS. When power fails, my internet, WiFi, the internet "radio," FM modulator, and those computer monitors keep right on going. And since those computers are laptops, so do they. Good bye switch-mode power supply noise!

Kill the Current With Ferrite Common Mode Chokes Sometimes it isn't practical to get rid of the noisy equipment – it may be expensive, something rather specialized, your XYL's favorite lamp, or something in your neighbor's home –so we must suppress the noise. The most useful technique is to apply a suitable ferrite common mode to the cable(s) that carry the noise current and radiate or receive the noise current. Our weapons of choice for the HF bands are clamp-on cores and toroids made with Fair-Rite Products #31 and #43 material. #31 is superior below 5 MHz, #43 is a bit superior above 14 MHz. I've always recommended #31 because it's a far more universally usable part, so we can save money by buying only #31 in larger quantity.

How Many Turns? For 40-10M, wind 5 turns through the clamps in Table 1; for 80-160 wind 7 turns, and for 6M use two turns, with several chokes in series. For chokes on toroids, use the data for small diameter wire in Appendix One of http://k9yc.com/RFIHam.pdf or the guidelines for small diameter coax in the Choke Cookbook in the same document. When counting turns, it's the number of times the cable passes through the ferrite core (one more than visible in the loop). *See Fig 6.*

Fig 7 – 5 turn choke, good for 7-30 MHz

What Cables Should Be Choked: Start by choking every cable connected to each noise source that you discover. If you can't kill the noise from that source, turn it off and move on to the next source. Continue choking all the noise sources until all are either successfully choked or turned off. Now you know what products are not fixable, and can think about replacing them with something better.

Buying Ferrite Cores: Never buy ferrite cores from vendors that advertise in ham magazines – they're selling at insanely high markups, and often the wrong parts for what we need. Instead, put together a quantity order for members of local ham clubs and buy from one of several good industrial vendors. You'll pay about 25-30% of what those ham vendors charge, and you'll get the right part. My current favorite vendor is Dexter Magnetics (near Chicago), others speak

Fig 6 – Digital Meter

How Ferrite Chokes Work

Common mode chokes work by adding a large value of resistive impedance in series with the common mode circuit. Most hams think of a common mode choke as an inductor. That is VERY wrong. Common mode chokes work using the resistance of the parallel resonant circuit formed by the inductance of the winding, the stray capacitance of the winding, and the resistance coupled from the lossy core.

The self-resonance of a conductor passing once through most ferrite cores used for suppression is in the range of 150 MHz, and this is where a core simply clamped around a cable will be effective. To obtain good suppression in the range of 1-50 MHz, we must wind multiple turns through the ferrite core to lower the resonant frequency. Inductance, of course, is the inductance of a single pass through the core multiplied by N squared, where N is the number of times the wire passes through the core. Because that resistance is inductively coupled, it is also multiplied by N squared. C is mostly the capacitance between turns, so it increases approximately proportional with the number of turns, and is a bit greater with large diameter cables. It can also be increased by squeezing the turns very close together (outside the core), or reduced by forcing them apart. Because these chokes are intentionally very lossy, their circuit Q is quite low (around 0.5) so precise tuning is not required.

At low frequencies, the fundamental equivalent circuit is simply that series R and L (because the value of C is too small to matter at low frequency), but as frequency increases and we approach resonance, C is in parallel, and for an octave or two both sides of resonance (an octave is a 2:1 frequency range), the circuit simplifies to parallel R, L, and C, where L is the inductance at low frequencies, C is the capacitance well above resonance, and R is the parallel equivalent resistance transformed from the series value.

The reason we want high resistance in our choke is that in the common mode circuit, which is really an antenna, the rest of the circuit can look inductive or capacitive depending on its length. A simple example is a dipole fed with coax, with the shield grounded at the transmitter. The common mode circuit consists of the dipole plus the coax – the coax looks like a grounded vertical long wire with top-

(Continued on page 25)

(Continued from page 23)

well of Lodestone-Pacific, and these two vendors are usually most competitive, but sometimes Allied and Newark are as well. I've been happy with Kreger Components, but their prices have not been competitive in recent years. All of these vendors will bill a credit card and charge it when they ship. This usually provides enough time to collect most of the money from your buyers. Don't go by catalog prices -once you have some idea about quantity, call them for quotes (and price breaks) for the quantities you think you might buy. Add to those quotes the cost of shipping and sales tax for your state.

Always buy full boxes – ferrites are brittle and break easily, but there will be virtually no breakage if they come packed by the factory – ask about box quantities. These vendors can ship a single order to 2-3 locations if that makes it easier for you to deliver, but don't ask them to split boxes. Never re-ship ferrite cores –they must be very well packed to prevent breakage, they're heavy, and they're expensive to re-ship. Insist at all buyers in the group pick up their order at a club meeting, or passed along from another member who does the pickup for them. Our first ferrite buy was split between clubs around Los Angeles and SMC members in three cities.

Fair-Rite Part Number	Shape	i.d. inch	o.d. inch	Length inch
0431164181	Clamp-on	0.5	1.55	1.22
0431173551	Clamp-on	0.74	1.15	1.65
0431177081	Clamp-on	1.0	1.7	2.2
2631803802	Toroid	1.4	2.4	0.5

Table 1 – Useful Ferrite Cores

Table 1 lists part numbers for cores I find most useful for suppression at HF and on 160M. All are #31 material. Lately I've been buying the 0.74-in i.d. clamps because I find them most universally useful. They're large enough for the medium-size cables I need to choke, like cables to video monitors and many power cables. The 0.5-in i.d. clamps are large enough for smaller cables, and are cheaper. The 1-in i.d. cores are pretty expensive (about $10) but are equivalent to three

2.4-in o.d. toroids; I save them for the largest cables.

Commercial Power Line Filters are generally effective only if installed inside equipment and bonded to the shielding enclosure. They are generally not effective when mounted outside equipment. The reason is simple – RF noise gets onto the Equipment Ground conductor (the "Green Wire" when it is not properly terminated to the chassis where it enters the noisy product (just like "The Pin One Problem," and the "Green Wire" does not go through the filter! This fact is further confused by the way in which "differential mode" and "common mode" is defined for power systems – differential mode voltage is that between Line (hot) and Neutral, and common mode is that between Neutral and the Equipment Ground (the Green wire). This is very different from how we as communications engineers define common mode, and the way we define it is what causes antenna action. Filters are specified as having common mode suppression, but they do nothing about suppressing common mode current! The same sort of common mode choke we would use on coax will be equally effective on power wiring.

This concludes Part One of this article. Part Two will address issues associated with a number of specific product types, including Low Voltage Lighting, Grow Lights LED Lighting, Plasma TVs, Variable Speed Motor Controllers, Wired and Wireless Ethernet, CATV systems, including VDSL leakage in the 75M band, computers and computer monitors, USB-powered equipment, doorbell transformers, and solar power systems. If you have encountered any issues that you would like me to address, or have learned something that might help others, please email me at k9yc@arrl.net

1) to reduce the area of the loop carrying the noise current,

2) reduce the area of the loop in the victim circuit, and

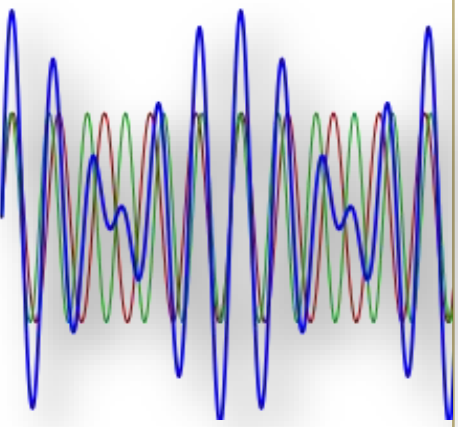
(Continued from page 24)

loading wires. If, for example, that vertical wire is between λ/4 and 3λ/4 wavelength, it will look inductive; if it is shorter than λ/4 or between 3λ/4 and 5λ/4 it will look capacitive. These relationships will repeat as the electrical length increases. If we had a choke with little resistance, it would still have parallel L and C values, which would form a series resonance with the L or C of that wire at some frequencies. When that happens, the common mode current will INCREASE, and be limited only by the resistance of the choke. But if the choke has enough resistance, that R will limit the current. Another example of a common mode circuit is a cable running between two pieces of equipment.

In the real world, we rarely model these circuits, because there are far too many variables that are subject to change from one installation to another. Instead, we take a "brute force" approach, making the resistive component of the choking Z as high as possible for the widest practical frequency range in which we need suppression. And if we need suppression over a wider range than one choke can cover, we add a second choke tuned to the rest of the operating range.

Ferrite materials that have "good" suppression characteristics are lossy in the frequency range where suppression is desired, although nearly all have low loss at much lower frequencies. Fair-Rite materials #31, #43, #44, #61, and a few others are optimized for suppression, and in that operating range, the circuit Q of their parallel resonance is on the order of 0.5. This allows a choke with a well placed resonance to cover a bit more than an octave. #61 material is an example of a material that is lossy at UHF, and thus useful for suppression above about 400 MHz, but has low enough loss below 20 MHz that it can be used as a core for high power transformers for the HF bands.

Most of these materials are NiZn compounds, and possess only the circuit resonance described above. #31 material is unique – because it is a very special MnZn compound, it exhibits both the circuit resonance at higher frequencies and a dimensional resonance at lower frequencies. When the circuit resonance is below about 6 MHz, the combination of the two resonances gives its impedance curve a very broad "double-humped" response, much like a stagger-tuned IF, providing nearly an extra octave of effective suppression. Its equivalent circuit is two parallel resonant circuits in series. Note that all MnZn materials exhibit dimensional resonance, but only in Fair-Rite's #31 is it carefully controlled to provide the broadband suppression described here.



3) separate the source and victim by as much distance as possible. In general, this means using twisted pair or coax for all signal wiring and running it in close proximity to bonding conductors between the equipment it interconnects (because the bonding and the signal wiring forms a magnetic loop).

Several years ago, ON4WW put up an excellent web page with more than twenty case histories documenting the successful pursuit of a variety of RF noise. It's well worth a read. http://www.on4ww.be/emi-rfi.html

~ Jim Brown K9YC
Reprinted with permission from the author.

Part Two of this article will be published in next month's Communicator -Ed.

A Scout Jamboree Question

I was a member of the Canadian contingent to the 1967 World Jamboree held at Farragut State Park, Idaho. While there, I visited a special Ham Radio shack that was in place as the voice of the Jamboree.

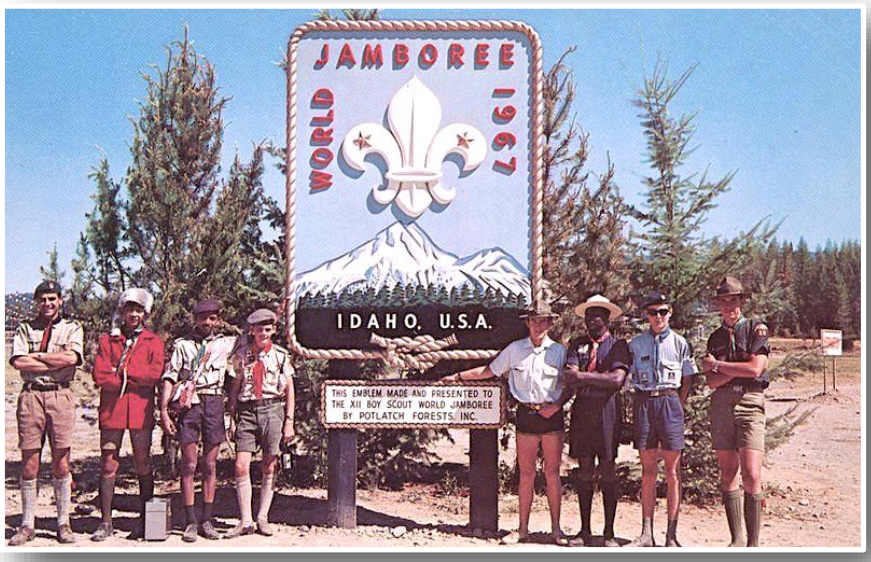
A few of the surviving members of the World Jamboree are having a re-union this summer.

I wonder if there is someone that would be interested in once again having the voice of the World Boy Scouts Jamboree on the air again?

As I recall, there was a special call sign used just for this jamboree, as well as a snazzy QSL card.

Thanks for your attention

~ Gary Coleman (604) 808-8074



Space Is Limited
Register Now!

Surrey Amateur Radio Club

Industry Canada
BASIC AMATEUR RADIO
Qualification Course

What Can I Do With My Radio License?

- Long range communications anywhere for free without commercial infrastructure
- Use satellite communication to speak around the world, perhaps even to an astronaut
- Participate in 'Radio Sports' like contesting and Fox Hunting
- Enhance your personal and your community's preparedness in an emergency
- Use a computer, smartphone or tablet for free worldwide digital communications
- Practice an exciting hobby

Learn In A Professional Setting
Qualified, Experienced Instructors

Practical Demonstrations
Technical Knowledge Not Required

Fee $100
Includes Course Manual

Surrey Amateur Radio Club
For more information on the course visit
www.ve7sar.net or contact
sarc@ve7sar.net

Course starts March 14, 2017
8 sessions on Tuesdays 6:30pm—9:30pm
plus one optional Saturday workshop
Surrey Fire Training Centre
14901 64 Avenue, Surrey, BC

Adam's Tech Topics

Adam Foley N1RKW

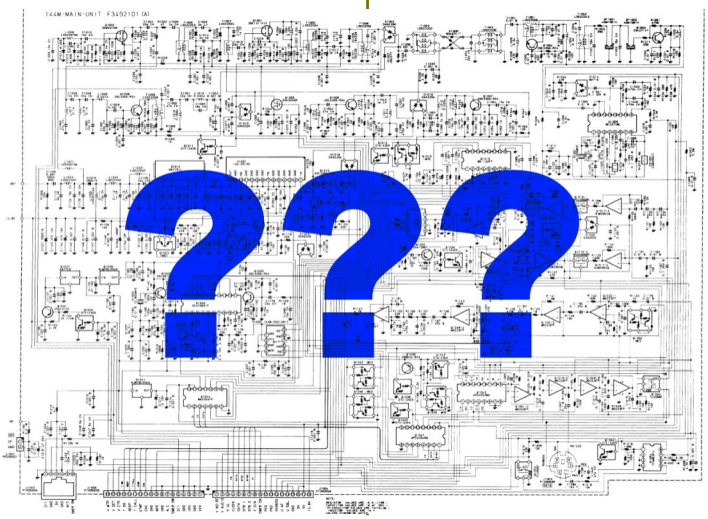
Making Sense Of Schematics

"...indecipherable mess of crisscrossing lines and symbols that resemble the hieroglyphics..."

During the insultingly cold February weather that we're putting up with for some ridiculous reason, working on anything outdoors isn't just difficult or potentially dangerous, it's downright foolish. Spending time outdoors for any reason other than absolute necessity this month risks the loss of body comfort, body heat, and body parts. In other words, this is a perfect time to dig out those indoor projects you set aside during those months when it was possible to exist outdoors without the need for 14 layers of wool and a portable kerosene heater.

I guess you could accuse me of not liking winter very much, but that would be unfair. I like it just fine, as long as I'm looking at it through multiple panes of glass while enjoying copious amounts of hot chocolate and nice, warm, included-in-my-rent baseboard heating. One would think that a New Hampshire native would be more tolerant of the cold, but not this one. I'd rather smash my fingers with a mallet than use them to make a snowball.

Confusing Schematic



So I'm a miserable old fusspot this time of year. Please don't let that keep you from reading this article, as it actually has nothing to do with winter, snow, cold weather, or my negative opinions of those things. It has to do with reading electronic schematic diagrams.

Have you ever sat down at your bench with the intention of trying to figure out why your two-meter rig has suddenly become deafer than a post, downloaded a copy of the radio's service manual and opened it up to the page with the schematic on it, only to be greeted by an indecipherable mess of crisscrossing lines and symbols that resemble the hieroglyphics that might have shown up on a wall in ancient Egypt had the person chiseling them out of the stone been completely and totally drunk? Something like the one shown at left.

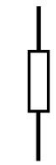
Yes, that looks like a confusing mess, which is a common issue with schematic diagrams from anything more complex than a crystal radio. These days, everything is more complex than a crystal radio. I was actually going to say "light bulb" here instead of "crystal radio", but it occurred to me that these days even something as simple as a light bulb has become ridiculously complex.

Fear not!

Schematic diagrams aren't actually as difficult to decipher as they look at first glance. All you need to do is break them down into smaller and smaller pieces. When you do this, you will find that nearly all schematics are constructed from the same few basic building blocks. Those building blocks correspond directly to the basic building blocks of electronics, things like resistors, capacitors, transistors, and diodes. Since I've gone over the function of those basic components in previous articles, I'll concentrate on how they are represented on paper (or pixels, I don't judge) in this article.

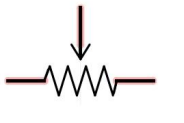
Let's start with what might just be the most basic and most widely used electronic component of all, the humble resistor. In a schematic diagram a resistor is represented as either a zig-zag line, which makes sense to me, or a rectangular block, which does not. Something like this:

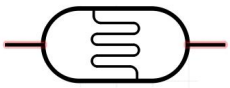

RESISTOR


ALSO A RESISTOR (for lazy schematic writers)

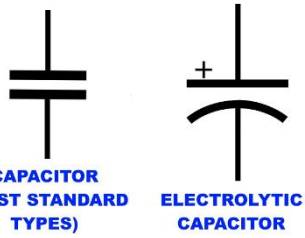
Usually you will see the value of the resistor, which is how much resistance it has, printed next to the symbol, but this isn't always as clear as it should be. Let's say our resistor is 2700 Ohms. The symbol for Ohms (a measurement of resistance) is the Greek letter Omega, or Ω. With this in mind, we might see the value displayed in any of the following ways (or others if the engineer was in a foul mood the day the schematic was written): "2700Ω", "2700", "2.7KΩ", "2.7K", or even "2K7". If that isn't confusing enough, there may also be a tolerance number, such as "5%" or "1%" in addition to the value. This tolerance represents how close to the desired value the resistor needs to be. In other words, our 2700Ω resistor, if it's a standard 5% resistor, could measure anywhere between 2565Ω and 2835Ω and be in spec. You're most likely to see 5% as the usual standard. 1% resistors are becoming more common these days, but anything with a tighter tolerance than that is usually only seen in test equipment. Most other components in a schematic will be labeled similarly to the resistors (and similarly confusing), so I won't be going into detail about how the part values are labeled again.

To make matters even more confusing than they already are (and we're still only at the beginning of the article), there are also other types of resistors. On the right are a couple more that you're likely to run into:


POTENTIOMETER


PHOTOCELL

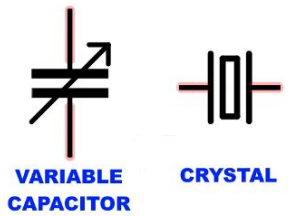
The one on the left is a potentiometer, or variable resistor. It's basically a regular resistor with a third contact that can be moved across the surface of the resistor, giving different values as needed. These are often used as volume controls in audio systems, or as a way of controlling almost anything and everything else. They really are that common. The one on the right is a photocell, which is a resistor that changes its value based on how much light it is receiving. They're used a lot in devices that have video displays, televisions for example, to adjust the brightness of the display based on the amount of ambient light in the room. They're also used a lot as examples in educational circuits such as the kind you will find in books written by Forrest Mims III. If you are trying to get started learning about electronics, there is no better place to start than with his books. Seriously, his books are awesome.



The next component on the nonexistent list I'm working from is the capacitor. A capacitor is made up of two plates of metal or strips of foil separated by a thin insulating material. Consequently, their symbol *[left]* looks something like these.

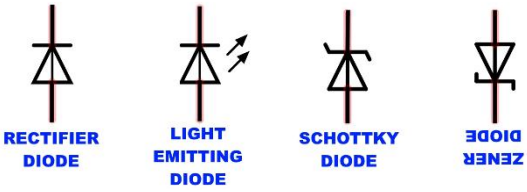
Nice and simple. The symbol on the left indicates a non-polarized capacitor, or one that doesn't care which way around it goes in the circuit. These can be any one of a number of different types of capacitors, including ceramic, mica, poly-film, and numerous others. The symbol on the right indicates a polarized capacitor, and these are a bit more picky. These are usually electrolytic caps and if they are put into the circuit backwards, with positive on the negative terminal and vice versa, they will probably be damaged. This damage can sometimes be catastrophic, with the capacitor puking out corrosive and toxic chemicals all over the inside of your beloved radio, so it's vital to install them correctly. They're usually clearly marked, though oddly it's the negative lead that's usually indicated, so keep this in mind when installing or replacing them.

Another couple of capacitors that those of us that routinely stick our noses under the hood of radios will run into are the variable capacitor and the oscillator crystal. The variable capacitor is often used in radio tuning circuits, and crystals are used to set a specific oscillator frequency, also often used in radio tuning circuits as well as almost every other electronic device known to mankind. They look like this *[left]* on a schematic.



Yes, oscillator crystals are actually a type of capacitor. They consist of two thin metal plates, often just a few microns thick, attached to a slice of quartz crystal that has been cut to an extremely precise size and shape to oscillate at a very specific frequency. In case you're curious, variable capacitors are usually made of a group of thin metal plates that can rotate into and out of another set of plates, making the total capacitance of the device adjustable.

Because the list that I'm working from to write this article doesn't actually exist, I'm not going in any kind of logical sequence. With that in mind, let's take a look at diodes next.



The one on the left is the run-of-the-mill rectifier diode, which is by far the most common type you will run into. It consists of a silicon or germanium chip that has been chemically altered to allow electrical current to only flow in one direction. It is useful for a large number of things including turning AC into DC, switching, and even detecting radio signals, the handy little buggers.

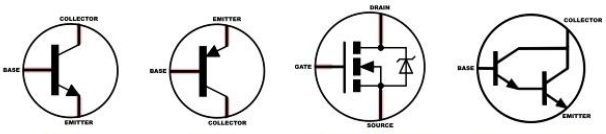
Next is the light emitting diode or LED. These are diodes whose semiconductor chip has been treated in such a way that they emit light when current flows through them. These have been getting a lot of attention lately, mostly because they are tremendously efficient at making light, and also because you can make all kinds of neat-o blinky things with them.

The next one is a Schottky diode, which is one that has been specially made to have a very fast switching speed and a lower voltage drop than a normal diode, and therefor a reduced

amount of electrical loss. There's a lot more to them than that, but I'd like to keep this article from becoming a 400 page text book.

On the far right is a Zener diode, and it is upside-down (relative to the others) for a reason. These are diodes that are made to work like a normal diode until a certain voltage has been reached, and then they start to work backwards and conduct in the opposite direction. Wired properly, they won't pass any current until the circuit's voltage reaches the zener diode's rated voltage. In other words, they can be used to maintain a specific voltage in a circuit. They are commonly used in voltage regulators, power supplies, and many other devices that need precise voltages.

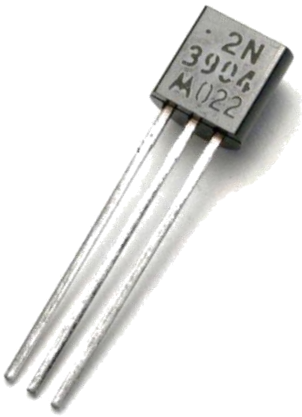
Speaking of devices that need precise voltages, here are some transistors:



On the left are the NPN and PNP transistors, which are the same but opposite. Naturally, that makes no sense whatsoever. I'd better explain a bit. "N" and "P" refer to the chemistry used to alter, or "dope", the silicon chip inside those transistors: "N" for negative type, and "P" for positive type. An NPN transistor is one that has a layer of positive doped silicon sandwiched between two layers of negative doped silicon. Consequently, when a positive current is applied to the "P" layer in the center, the transistor will conduct. A PNP transistor acts just the opposite, requiring a negative current applied to the "N" layer in the center of the sandwich before it will start to conduct. In order to tell these two similar looking types of transistors apart on a schematic, all you have to remember is this: NPN means "Not Pointing In". Go ahead and take a look at the arrow in the diagram for the NPN transistor and then compare it to the one for PNP. You'll see what I mean. Just remember that little helpful saying and you'll never have any trouble telling them apart, at least not on a schematic. In real life you're on your own because they all look exactly the same, muahahaha...

Next we have an awesome little device called a MOSFET. This symbol is for an "N-Channel" version, which is by far the most common, but there are also "P-Channel" MOSFETs as well. To answer your question, MOSFET stands for Metal-Oxide Semiconductor Field-Effect Transistor. It's that "Field-Effect" that makes these things so cool. Instead of needing a relatively large current to get the transistor to conduct a somewhat larger current, a FET only needs the gate voltage to be high enough for the thing to be tricked into conducting massively huge amounts of current between the source and drain. The gate current needed is so amazingly low that some FETs will continue to conduct after the power is removed, because the capacitance of the gate stores enough of a charge to keep the darn thing going. FETs are fun to discuss, but I should probably try to keep this rolling (yeah, right). I strongly suggest that anyone interested in basic electronics spend some time researching FETs and playing with them. They're very, very easy to use. Even someone as educationally challenged as me can

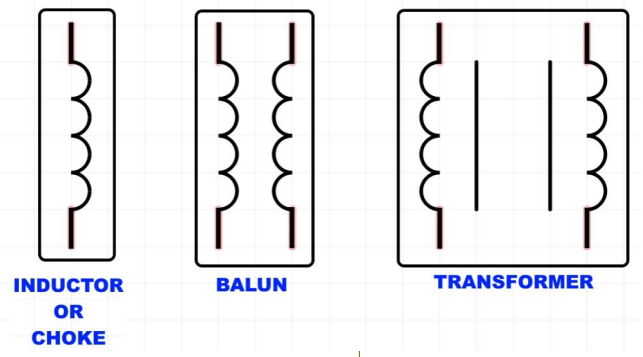
"...NPN means Not Pointing In."



have success with them, and indeed I have.

Okay, back on track. The transistor on the far right is what's called a Darlington transistor, which is basically two NPN transistors in one package. The upshot of this is that you get a single transistor package with very high gain. This is advantageous in many situations, but there are some trade-offs, not the least of which are a slower switching speed and a larger voltage drop through the device and therefor more electrical loss. If these don't bother you, a darlington transistor can provide a way to control a rather large amount of current with a small one, in one convenient package. They have many uses in different kinds of circuits, but I have run into them mostly in power supplies. That could be, of course, because I tend to work on a lot of power supplies...

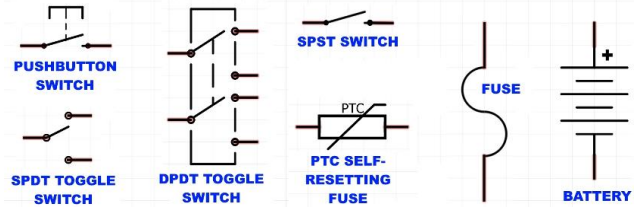
Speaking of power supplies, inside of them you will usually find at least one of the parts on the next set of diagrams:



The one on the left is a simple inductor, often referred to as a choke. It consists of a single coil of wire wrapped around a core made of iron, steel, ferrite, or even air. Air-core chokes are indeed a thing, as well as a whole host of chokes in other sizes, shapes, colors, and flavors.

The center symbol is that of a balun, something that should be familiar to most of us hams. The symbol is made up of a pair of chokes back to back, which makes sense when you think of the balun as a type of transformer, which it is. And this brings us to the next symbol: The transformer. A transformer is made up of two or more coils wound on a core of iron, steel, ferrite (powdered iron ceramic), or even air, though air-core transformers are pretty rare (unless you're talking about baluns). Most power transformers you will see are wound onto a core of laminated steel plates, though transformers made for high frequency use, such as those found in switch-mode supplies, are often wound onto ferrite cores.

Other symbols you are likely to see on most schematic diagrams are various types of switches, such as these ones here:



The function of a switch is, obviously, to turn something on or off. That being said, there is more to them than just that over-simplified description. Switches are often described in terms of how many sets of contacts, or "Poles", they have within them, and how many positions, or "Throws", those poles can be switched to. For example, a simple wall switch that is in common household use to turn the lights on and off is called a "Single-Pole, Single-Throw" switch. That can and should be shortened to SPST, because that's how they're labeled on schematic diagrams. The symbols labeled "Push-button Switch" and

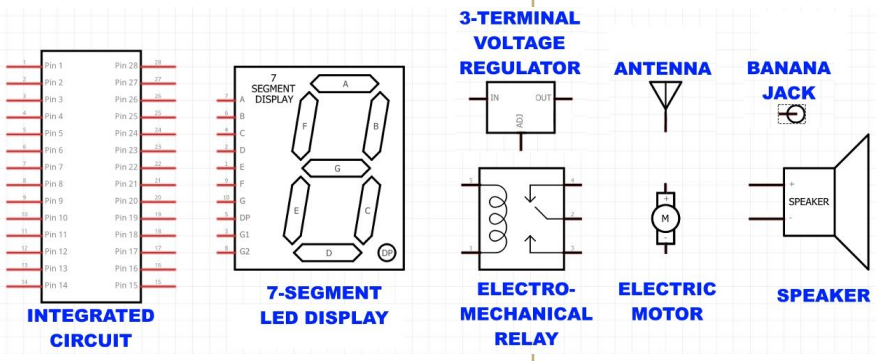
"SPST Switch" are both SPST switches. The difference is that the push-button switch is a "Momentary" switch, which is one that doesn't stay on when you let go of it. Add a second connection so that you can switch between two different things, and you have a "Single-Pole, Double-Throw", or SPDT switch. You can see an example of that in the lower left corner. Now take that SPDT switch and add a second set of contacts that are controlled by the same lever, or "Toggle", and you have a "Double-Pole, Double-Throw", or DPDT switch. These are very common in electronics. There are switches with many more poles and throws, so it's not unheard of to see a 3P4T switch, especially in industrial circuitry.

Now you might be wondering why I included fuses and a battery in the same chart as switches, and that's because fuses can be considered a kind of switch. Batteries cannot, but I needed someplace to stick the diagram so that you could see it. That's what it looks like. There you go.

A regular fuse, the kind that blows once and needs to be replaced, is usually represented similarly to the one here, as a squiggly piece of wire. The reason? Because that's what most fuses actually are. They are really nothing more than a small piece of wire designed to melt and disconnect the circuit when a certain amount of current flows through it. There are more complex types with various features added to them, but at their heart they're still just a squiggly piece of wire.

PTC fuses are different. PTC stands for "Positive Temperature Coefficient", which simply means that the hotter it gets, the more resistance it has. Conversely, when they cool off again their resistance returns to normal. Running an electrical current through them causes them to heat up, and as the current is increased they get hotter. Since their resistance will sharply increase to the point where the circuit can no longer function when the PTC reaches a certain temperature range, PTC devices can be used as self-resetting fuses in many types of circuits where safety concerns do not require a standard fuse to be used instead. They are being seen more and more often in consumer electronics these days, which might be why many electronic devices respond favorably to being turned off and back on again when something goes wrong.

Here are a few other devices that you are likely to run across when working with, working on, or playing with electronics:



On the left side of this chart is the integrated circuit, or "IC". They come in all shapes and sizes, and the same is true of how they are represented on paper. This is just one example, but you should be able to recognize one when you see one, mostly by the fact that they look like they have more connection points on them than you can count in a week. Next to that is the common 7-segment LED display. You will find those in clocks, digital meters, bathroom scales, and anything else that hasn't switched over to vivid, full color LCD video screens. In other

Adam Foley N1RKW has been around ham radio most of his life, but didn't smarten up and get his license until 2008. Since then he has gone on to great heights (the 12' high roof of his old house, and the 3rd floor apartment he's in now), and recently decided to take up writing a monthly column about ham radio and electronics, two of the subjects he knows a little bit about (but not much). He lives in Laconia, NH with his incredibly tolerant wife and equally tolerant son and can be reached at I can be reached by email via N1RKW at hotmail dot com.

words, they are commonplace in electronics from the 1980s.

Next we have an electromechanical relay, which I should have included with the switches because that's exactly what they are. They are switches that are controlled by running a current through a built-in coil (called a "Solenoid" in this case), which creates a magnetic field that pulls the switch closed, hence the terms "electro" and "mechanical". Very clever. People have built fully functional but slow computers out of relays, but you might want to start with a smaller project than that if you're trying to learn about them.

Above the relay is a 3-terminal device that is, in this case, an LM78xx series voltage regulator. Technically, any IC with 3 terminals could use that same symbol. I just wanted to show that specifically because you will see a lot of those when working on radios and power supplies. The LM7808 is particularly common in mobile ham radios, as it provides a stable 8 volts for the control circuitry within those rigs. Another commonly seen one in that series that is the LM7805, which does the same thing but puts out 5 volts instead. As you might have guessed, the numbering scheme is pretty easy: 7805 = 5v, 7809 = 9v, 7812 = 12v, etc.

To the right of the voltage regulator is something that might look surprisingly familiar to you: a schematic symbol for an antenna. If you've had any dealings whatsoever with the ARRL, you'll recognize the antenna symbol as part of their logo. In fact, their logo actually contains a schematic diagram for the simplest radio circuit: an antenna, a coil, and Earth ground.

See it?

What has been seen can never be un-seen. You're welcome.

The last few components are fairly self-explanatory. Below the antenna is the symbol for an electric motor, a circle with an "M" in it and a pair of rectangles which probably are there to represent the motor brushes (the part of a motor that transfers power to its rotor, though not all motors have them). To its right is the symbol for an audio speaker, which looks just like an audio speaker for some reason. Above that is the symbol for a "Banana" jack, and yes, they really are called banana jacks and banana plugs. They are commonly used in test equipment, particularly on the ends of test leads for multimeters.

Trivia time: Did you know that the center conductor of a PL-259 antenna connector is the same size as a banana plug? The PL-259 and its female counterpart the SO-239, were originally created as a way to make a shielded banana plug and jack.

And so we have reached the end of this rather long and hopefully not boring article. I need to give a tip of the hat to both Yaesu, whose FT-8500 schematic I defaced, and Fritzing, whose excellent free software I used as a source for nearly all of the schematic symbols seen in this article. If you want an easy way to create your own schematic diagrams, check out

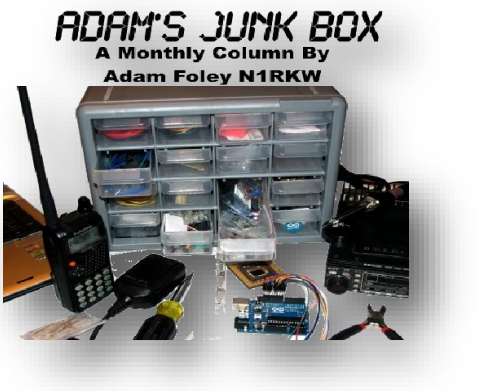
Our Radio Amateurs of Canada logo is similar to the ARRL logo referred to in Adam's article with the exception that the inductor is not shown.—Ed.

Fritzing. It may not have all the tools that a more professional level CAD program would have, but it is a heck of a lot easier to use and it's free. Did I mention that it's free? Oh, it's also free.

Okay, we weren't quite at the end yet. Now we're at the end. You can reach me in the usual way, by looking up my profile on QRZ and then emailing me with all of your ideas, questions, comments, and abuse.

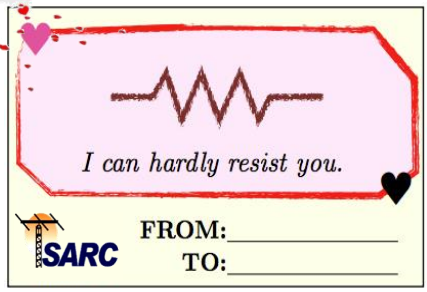
Thank you all for reading this article.

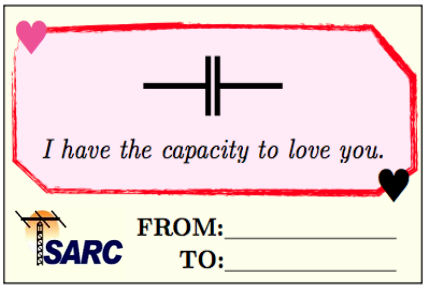
~ Adam Foley N1RKW



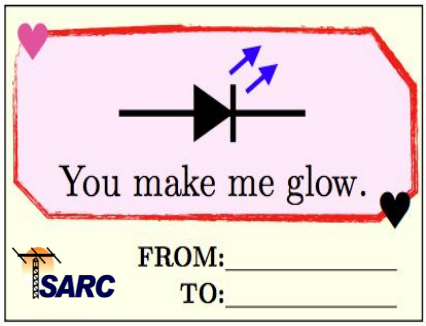
Guest Columnist Adam Foley N1RKW is a member of the Central New Hampshire Amateur Radio Club and contributes a monthly column "Adam's Junk Box" to their newsletter, also called The Communicator.

Adam also has a YouTube Channel





from your friends at SARC



A Special Event

John Brodie VA7XB

VIMY 100

"In April of 1917, four Canadian Divisions, fighting as a unified force, using new tactics derived from the recent Battle of the Somme, captured the main part of the Ridge on the first day of combat and completely occupied the entire ground in four days. Vimy Ridge remained in Allied hands for the rest of the war and served as the base for the wireless operations of the Canadian Corps of Signals.

The Vimy success was welcome news to war-weary Canada and it stirred a new sense of nationhood that some historians describe as the "moment when Canada leapt in spirit from colony to nation"

You should have already heard about the VIMY commemoration on the net, at SARC meetings, TCA magazine or in the Communicator…

If you want to know more about VIMY, please see the following websites:

http://ve100vimy.ca/; http://www.vimyfoundation.ca/; and https://en.wikipedia.org/wiki/Battle_of_Vimy_Ridge

April 2017 marks the 100th Anniversary of the Battle of Vimy Ridge and presents a one-time opportunity for SARC members to participate in a unique amateur radio event celebrating the victory and what it meant to our nation. A number of local amateurs will be traveling to France to participate in the VIMY commemoration, but our role will be on the home front.

Amateur radio activities across Canada preceding the VIMY anniversary started January 1st and will continue through April 2017. Each province gets its turn and BC operators will be on the air the entire week of Feb. 12th.

SARC has committed to be operating on Friday, Feb. 17th from 7 am to 4 pm (or possibly later)/ Assuming we get a sufficient number of volunteer operators, we plan to operate two stations:
Station 1) modes in order of priority: SSB, digital and CW at the OTC (aka the "clubhouse"), and

Station 2) modes in order of priority: CW, digital and SSB at VA7XB's home station.

Both Stations 1 and 2 will use the callsign VE100VIMY/VE7. Bands operated will depend strictly on conditions.

This is not a contest, rather it is a chance for amateurs in Canada and around the world to celebrate VIMY by making contacts with designated Canadian amateurs using the callsign VE100VIMY/VE7 and receive a QSL in confirmation.

Operators are needed to take shifts at both stations. Some experience in contesting would be an asset, i.e. this is not for absolute beginners. To participate you should have gained some confidence participating in a minimum of one (and preferably more than one) previous contest on the mode of your choice. Note: this is a good reason to sign up for the BC QSO Party on Feb. 14th, to demonstrate your skills.

We propose to divide both events into 2 hour shifts at each of the two stations. If we get sufficient number of volunteers we will request more hours. If not, we may request that you take 2 or more consecutive shifts.

If interested and qualified, by return email please advise the following:

Your preferred mode: SSB, CW, RTTY or PSK

Your preferred Shift: 7-10 am, 10 am-12 noon, 12-2 pm, 2-4 pm

~ SARC Organizers:
John VA7XB and Sheldon VA7XNL

The Contest Contender

John Brodie VA7XB

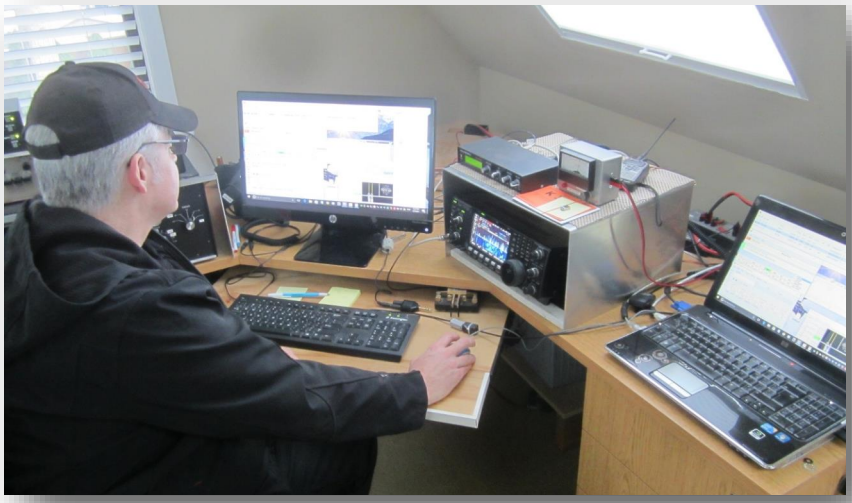
ARRL RTTY Roundup

Every contest is a challenge in its own way and this one was no different. The ARRL RTTY Roundup started at 10 am on Saturday, Jan. 7th and I took the first shift so I could be confident everything was functioning as it should before the visitors arrived. We decided to use the callsign CG7SAR as allowed under the Canada 150 birthday rules, with the linear amplifier cranked up and the beam at full height to make the experience the most productive possible.

All appeared under control to begin with, but very soon odd things started happening. First I noticed that the frequency on the IC-7600 wasn't tracking N1MM properly, though it was OK on the antenna controller. A shutdown and startup of N1MM rectified this glitch but it was a bad omen. Then a new issue soon became evident: Much to my consternation, once the function key was pressed to launch the macro, the callsign and exchange would send repetitively and nothing would shut them off, not even the escape key. The station on the other end must have wondered what kind of idiot was operating. To terminate the repetitive sending I was forced to turn off the transmitter which, of course, aborted the contact. Grrr…

In desperation, thinking it might be an "RF in the shack" problem, I tightened all the ground connections and slapped on a few ferrite cores where they might do some good. Then things settled down and I began to make progress once again. By 1 pm it was Sheldon VA7XNL's shift but he immediately began having trouble too, only this time the transmitter was shutting down in the middle of contacts. Clearly, something more serious was amiss. Little did we know at first the problem was a simple one. Then Sheldon noticed that the voltage on the monitor was swinging between 13.8 v on idle and 11.8 v on transmit. This is too low a voltage for the rig to run properly so it turns itself off. However, the power supply was not the problem, as its voltage held steady under load, but at the distribution panel it was fluctuating.

We quickly discovered the cause … we had a defective, over-heated 40 amp fuse on the rig runner that was causing an unacceptably large voltage drop in the power delivered to the transmitter. One terminal of the fuse could be seen to have melted with the heat even though the fuse still provided continuity. We replaced the fuse and now the voltage dropped only to 12.6 v on transmit. Back in business again! Thereafter we were able to make good progress with no further aggravations. It should be noted that oxidized fuse terminals are a common



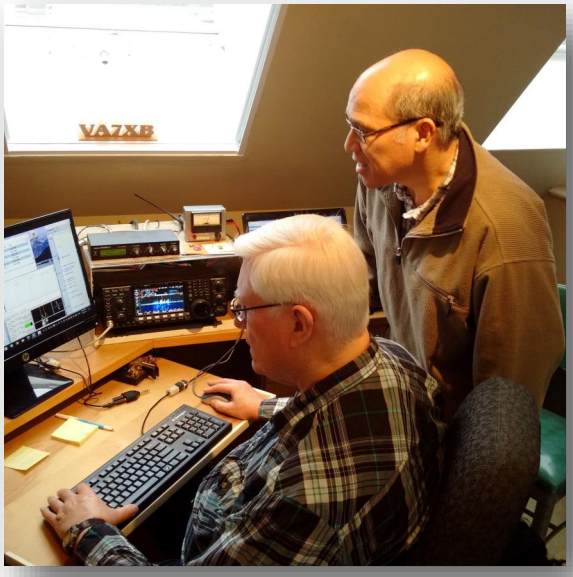
Operator	RTTY	Tot	Accum
VA7FMR	44	44	44
VA7XB	51	51	95
VA7XNL	45	45	140
VE7SSD	104	104	244
Total	**244**	**244**	**244**

problem but can be easily detected if you monitor your station voltage – my home-made low voltage monitor demo'd at a recent meeting has proved itself! A few more Qs on 40 m during the evening and then most activity had ceased.

Sunday morning and Robert VA7FMR arrived for his first ever experience on RTTY. With a short period of instruction, he quickly got the hang of it and started piling up the contacts on 20 m, then later moved to 15 m. By the time his shift was over, he had confirmed 44 contacts, not bad for a beginner. Anton VE7SSD then arrived around noon, and soon jumped into "Run" mode which brought in the contacts without stop for an hour or more before the pileup dried up, with 104 contacts confirmed during his shift.

Conditions were very poor. Many spotted North American stations could not be heard at all and there was virtually no DX other than a few South Americans and the occasional JA, nevertheless, it was a very fulfilling exercise and all look forward to the next challenge, the BC QSO Party on Feb 4th. Who will join the party?

~John VA7XB



VHF Radio

Johnny Angel W4XKE

A Look Back at the HTX-202 and 404

The Radio Shack HTX-202 (2m) and HTX-404 (70cm) were sold during the 1970s. There are still lots of them around, often for little money. I used one as an APRS transceiver for years.—Ed.

Don't ask me to sell you my Radio Shack HTX-202 because it isn't for sale! Sure, it's big and heavy and it looks a bit beat up from years of service but it's still favored over any other HTs. When I leave the house, the 202 goes with me and the others stay at home. Radio Shack may be called to task in many respects but this 2 meter handy talky is definitely a great radio.

The Tandy Corporation conscripted Maxon in Korea to build them a radio based on a design they had previously purchased from Icom. The result is the Realistic HTX-202. It has few bells and whistles but what it lacks in features, it makes up for in longevity. Over the years, my 202 has been used as a base station with an amplifier, an APRS portable positioning unit, the usual belt clip communicator and recently a radio link to the IRLP network. There is something very satisfying about working Europe on 1 watt with a radio that has a cash value of about 50 bucks.

The bottom line being, if I drop it over the railing of my boat, I'm only out a fraction of the price of one of my other radios. (That's only one reason all the others stay safely at home.) The "mil-spec" rating given to many other handy talkies is almost laughable when compared to the robust construction of the venerable HTX-202.

Before you go out and spend big money on a new HT, you would be well advised to spend considerably less for a used 202 and to then use the savings on something else that you'd like to have for your station. There are just a few things to keep in mind:

- Don't operate the HTX-202 without the belt clip. (It performs double duty as a heat sink for the final amplifier transistors.)
- Don't operate on auxiliary power without removing the battery pack. (This will protect the Zener diodes from excessive heat.)
- Don't buy a 202 with the intent of hacking it to increase its frequency range, as it doesn't lend itself well to such modification. (A good thing.)
- Don't walk away from a good deal because the original battery pack has died. (The NiMH replacement cells will make this great radio even better!) The original came with both Ni-Cad and a separate AA battery holder.

Here are a couple of links to find a replacement battery pack for your radio:

http://nicdlady.com/radio_pr-rt.htm

http://www.batteriesamerica.com/radio_shack.htm

Here is a list of Radio Shack links for support documents:
http://support.radioshack.com/support_electronics/15563.htm

~ Johnny W4XKE

Radio Amateurs of Canada

William James "Bill" Gillis, VE1WG SK

Radio Amateurs of Canada has received the sad news that former RAC President, Bill Gillis, VE1WG, became a Silent Key on Monday, December 26, 2016 at age 87.

The following information was extracted from the online obituary notice. RAC extends its sincere condolences to Bill's family and friends.

William James "Bill" Gillis, 87, of Moncton, with his loving family at his side, passed away peacefully at The Moncton Hospital on Monday, December 26, 2016. Born in Campbellton, New Brunswick, he was the eldest son of the late William James and Mary (Haley) Gillis.

His lifetime career was in the technical and management fields of the telecommunications industry with postings to various Maritime centres as well as St. John's, Montreal, Toronto, and internationally for 15 years in Tanzania, East Africa. Throughout his life he was active in the Amateur Radio Service, holding station licence VE1WG since 1946, VE3WG in Ontario and 5H3WG in Tanzania.

Bill served as RAC President (2002-2003) and as Director for the Maritimes Region. He served two terms as President of the Moncton Area Amateur Radio Club where he also conducted licence qualifying instruction and edited the club's monthly newsletter. He was a member of the Montreal Amateur Radio Club and the Oakville Radio Club. He had been an active member of the Beausejour Curling Club and the Beaver Curling Club.

His many accomplishments included playing piano, woodworking, genealogical research and climbing Mount Kilimanjaro. Bill was well read and enjoyed writing about many historical events that he researched very thoroughly. He most enjoyed welcoming friends and family to his home of 54 years in Harrisville (especially the Thursday lunch crowd), and helping his many grandchildren with their projects in his shop whenever he could. He also took great pride in his participation to influence the naming of Harrisville Boulevard.

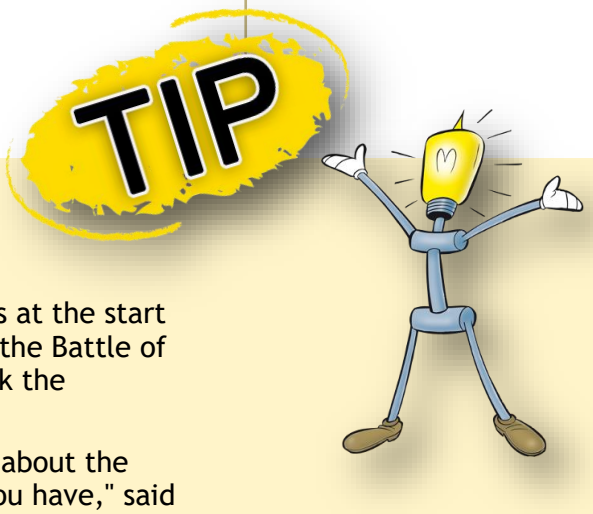
Bill will be sadly missed by his devoted wife of 65 years, Patricia "Pat" (Picot); his cherished children, Diane Prosser (Eric), Donald Gillis (Kathy), Daniel Gillis (Timmie), Kathie Blomsma (Paul), Patti Trites (Steve) and Michael Gillis (Janet), all of Moncton and Peter Gillis (Trina) of Leduc, AB; his adored grandchildren, Derek Prosser, Jeff Prosser (Mariel), Audrey Cochrane (Matt), Laura Frost (Brady), William Gillis, Jessica Gillis (Luc Doiron), Jim Gillis (Manon Boudreau), Kristi Hughes (Tyler), Andrew Trites (Sarah), Ben Trites, Jordan Gillis (Samantha Scribner), Tommy Gillis, Katie Gillis,

The new version of RIC-3 can be found online at:
http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf01008.html

Shanna Gillis; his precious great-grandchildren, Marissa Prosser, Molly Cochrane, Ruby Cochrane, James Frost, Mary Frost, five day old Liam Gillis and soon arriving Amelia Hughes; his brothers, Robert Gillis (late Janice 1999) and Ralph Gillis (Alice Marie); God-daughter, Patsy Burton; sisters-in-law, Claudette Picot (Don) and Jeannine Cochrane (late Bill 2015); brother-in-law, Jules Picot (Carol); several loving nieces, nephews and cousins.

In addition to his parents, he was predeceased by his sister, Mary Elizabeth Gillis (2016) and his beloved great-granddaughter, Hailey Amelia Hughes (2015).

The Canadian Amateur (TCA), Canada's premiere national magazine devoted to Amateur Radio, is published six times per year and is the membership journal of the Radio Amateurs of Canada. It is available in both print and digital versions and includes regular columns, features and technical articles of interest to Amateur Radio operators. In addition, a Coming Events calendar, Feedback, QSL Bureau information and coverage of regulatory issues are also provided. For more information about TCA including an Author's Guide and an Advertising Rate Sheet visit the TCA webpage. Here is a free full-colour sample copy of TCA for downloading: July-August 2015 TCA



Provinces taking turns with VE100VIMY call sign

Four Prince Edward Island amateur radio operators spent hours at the start of January spreading the word about the 100th anniversary of the Battle of Vimy Ridge. Industry Canada created a special call sign to mark the anniversary: VE100VIMY.

Amateur Radio operators reached 2,400 people and told them about the famous Canadian victory. "It's a very short conversation that you have," said Ron Huybers of Kensington, one of the four operators. "You exchange name, what kind of equipment they run, and a lot of people ask us, 'What is this all about?'" Huybers said the farthest person he reached was in Namibia, in southern Africa. He said at least 60 per cent of the people he spoke with knew about the battle. Bill Glydon of Alberton, P.E.I., Doug Silliker of Summerside, P.E.I., and Ken McCormick of Clinton, P.E.I., also participated.

Amateur radio operators in each province get to use the call sign for a week. Nova Scotia was first, then P.E.I. All provinces and territories will get a chance this year. The goal is to attract visitors to the national website Canadian War Museum: The Battle of Vimy Ridge.

BC has its turn the week starting February 12. SARC will have a special event station on February 17th.

Check It Out

John Schouten VE7TI

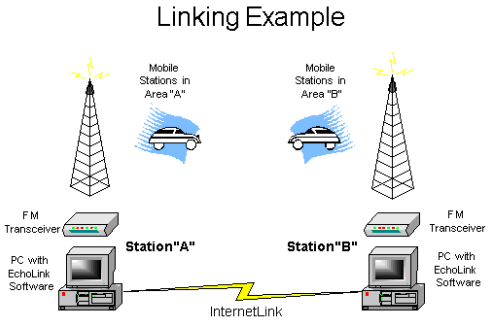
EchoLink® For Smartphones,Tablets and Computers

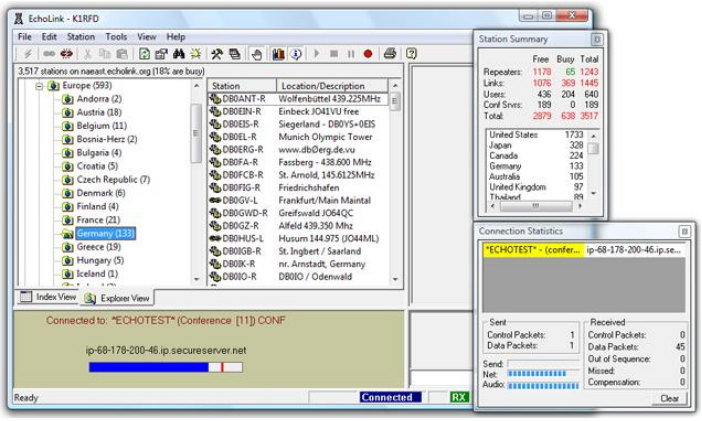
You may have heard me use Echolink to check into the SARC Net on my travels. It works very well for me whether I'm using my computer (Mac or Windows), tablet or smartphone. Installation and use are very easy and it works almost like a 'real' radio… or even better as the signal is always crisp and clear and I have no worries about an antenna.

EchoLink® software allows licensed Amateur Radio stations to communicate with one another over the Internet, using streaming-audio technology. The program allows worldwide connections to be made between stations, or from computer to station, greatly enhancing Amateur Radio's communications capabilities. There are more than 200,000 validated users worldwide — in 151 of the world's 193 nations — with about 5,200 online at any given time.

Validation

EchoLink opens a world of new communications possibilities by joining Amateur Radio stations over the Internet. Since the Internet is a shared, public resource, security is naturally a very important part of the system. Each new user of EchoLink must provide proof of license before access is granted. This is to ensure that only licensed Amateurs have access to the system, and to ensure that each user is using a valid callsign that he or she is authorized to use. There are several different ways you can provide proof of license. These options vary somewhat by country. The various options are explained on the website. The purpose of this request is not to determine whether the callsign is valid (that can often be checked elsewhere), but to verify that you are indeed the licensee, in other words, to prove your identity.





Submitting Proof of License

If you wish to be validated, the document you send must be a photocopy (or digital photograph) of the Amateur license, showing the callsign under which you are requesting validation. If you live in a country where operator licenses and station licenses are separate documents, you must provide the station (or apparatus) license. Unofficial documents, such as QSL cards, award certificates, and callbook pages cannot be accepted for validation.

For more information about Internet linking programs such as EchoLink, see *QST* for February, 2003, page 44, or download the PDF from the ARRL Web site.

~ John VE7TI

February 2017

Sun	Mon	Tue	Wed	Thu	Fri	Sat
			1	2 1930 SEPAR Simplex Check-in	3	4 0900 Klub Koffee Klatch: Kalmar Family Restaurant, King George Blvd & 81st Ave. CONTEST: BC QSO Party
5	6	7 **1930 SEPAR Net** **2000 SARC Net**	8 **1900 SARC General Meeting**	9 1930 SEPAR Simplex Check-in	10	11 0900 Klub Koffee Klatch: Kalmar Family Restaurant CONTEST: CQ WW WPX (RTTY)
12 CONTEST: CQ WW WPX (RTTY)	13	14 **1930 SEPAR Net** **2000 SARC Net** 	15	16 1930 SEPAR Simplex Check-in	17 VIMY100 SARC Special Event Station	18 0900 Klub Koffee Klatch: Kalmar Family Restaurant CONTEST: ARRL International DX (CW)
19 CONTEST: ARRL International DX (CW)	20	21 **1930 SEPAR Net** **2000 SARC Net**	22 **SARC Exec Meeting**	23	24	25 0900 Klub Koffee Klatch: Kalmar Family Restaurant CONTEST: NA QSO Party (RTTY)
26 CONTEST: NA QSO Party (RTTY)	27	28 **1930 SEPAR Net** **2000 SARC Net**				

For details on all SARC events, go to ve7sar.net

For details on all SEPARS events, go to separ.shutterfly.com/calendar

Contest Details: http://hornucopia.com/contestcal/contestcal.html

CLUB EXECUTIVE 2015-2016

PRESIDENT
Stan Williams VA7NF

VICE PRESIDENT
Anton James VE7SSD

SECRETARY
Jeremy Morse VE7TMY

TREASURER
Scott Hawrelak VE7HA

DIRECTORS
John Schouten VE7TI (Communicator Editor)

Sheldon Ward VA7XNL (Repeater Manager)

Bill Gipps VE7XS

Mike Plant VE7AT

On the Web

ve7sar.net
or
docs.com/surrey-amateur-radio-club

Between newsletters, watch your e-mail for announcements of events, monthly meetings and training opportunities. These announcements can also be found on our web pages, or via:

Twitter
@ve7sar

FaceBook
SurreyAmateurRadio

Our YouTube Channel
SurreyARC

SARC Photo Albums
Web Albums
or
tinyurl.com/SARCphoto

QRT

John Schouten VE7TI

A Final Word On VE100VIMY

In the past few issues we have reported extensively on the special event callsign VE100VIMY, being used by Canadian Amateurs throughout the month of February.

For those that may not be aware, many historians and writers consider the Canadian victory at Vimy a defining moment for Canada, when the country emerged from under the shadow of Britain and felt capable of greatness. Canadian troops also earned a reputation as formidable, effective troops because of the stunning success. But it was a victory at a terrible cost, with more than 10,000 Canadians killed and wounded.

The Canadian Corps was ordered to seize Vimy Ridge in April 1917. Situated in northern France, the heavily-fortified seven-kilometer ridge held a commanding view over the Allied lines. The Canadians would be assaulting over an open graveyard since previous French attacks had failed, with over 100,000 casualties.

The capture of Vimy was more than just an important battlefield victory. For the first time all four Canadian divisions attacked together: men from all regions of Canada were present at the battle. Brigadier-General A.E. Ross declared after the war, "in those few minutes I witnessed the birth of a nation."

Vimy became a symbol for the sacrifice of the young Dominion. In 1922, the French government ceded to Canada in perpetuity Vimy Ridge, and the land surrounding it. The gleaming white marble and haunting sculptures of the Vimy Memorial, unveiled in 1936, stand as a terrible and poignant reminder of the 11,285 Canadian soldiers killed in France who have no known graves.

The centenary of the Battle will be marked in April 2017 by formal ceremonies to be held at the base of the monument which will be attended by Heads of State.

Approximately 2 km away, but still at summit level, a commemorative amateur radio station with the call sign VE100VIMY, will operate from April 1 to April 9, 2017. There will be two stations and appropriate antennas working on a 24 hour basis. The event is being organized by the Vimy Commemorative Station Society, a registered in British Columbia Society, in coordination with a number of leading Canadian amateurs.

Most of us cannot travel to Vimy for these commemorations or to operate there, but we can still be part of this special event. During the week a number of stations in BC will be hosting the callsign for a day, as will SARC on February 17th. A 7am - 5pm block has been assigned to our club.

On Friday, February 17th Sheldon VA7XNL will open the OTC station and John VA7XB has volunteered to open his home station Please make an effort to participate.

Till next month, 73

~ John VE7TI
Communicator Editor

It's February!

At our meeting on February 8th we look forward to Stan's SDR presentation—Part 2, postponed from January due to technical difficulties.

SARC hosts an Amateur Radio net each Tuesday evening at 8 PM. Please tune in to the VE7RSC repeater at 147.360 MHz (+600 KHz) Tone=110.9, also accessible on IRLP node 1736 and Echolink node 496228.

On UHF we operate a repeater on 443.775MHz (+5Mhz) Tone=110.9 or IRLP Node 1737.

	SARC Net 20:00 Hrs
1st Tuesday Standby	Drew VA7DRW Rob VE7CZV
2nd Tuesday Standby	Jinty VA7JMR Sheldon VA7XNL
3rd Tuesday Standby	Rob VE7CZV Vacant
4th Tuesday Standby	Kapila VE7KGK John VA7XB
5th Tuesday Standby	Robert VA7FMR Rob VE7CZV
Want a turn at Net Control? Contact the SARC Net Manager	

Down The Log…

SARC Monthly Meetings

2nd Wed. (Sept-Jun)
1900 hr at the PREOC
Emergency Mgmt BC
14292 Green Timbers
Way, Surrey, BC

Weekly Club Breakfast

Saturday at 0900 hr
Kalmar Family Restaurant
8076 King George Blvd.
Surrey

SARC Net

Tuesday at 2000 hr local
on 147.360 MHz (+)
Tone=110.9

SEPARS Net

Tuesday at 1915 hr local
on 147.360 MHz (+)
Tone=110.9

VE7RSC Repeaters

2m: 147.360MHz+
Tone= 110.9Hz
IRLP node 1736
Echolink node 496228

1.2m: 223.960 Mhz -1.6
Tone=110.9

70cm: 443.775MHz+
Tone= 110.9Hz
IRLP node 1737

We Have A SARC Patch!

These are suitable for sewing on a jacket, cap or your jammies, so you can proudly display your support for the club.

The price is $4 each or three for $10 and they can be picked up at a meeting or the weekly Koffee Klatch.

We thank our sponsors for their SARC support.

Please support them.